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Volume 83, Number 8
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Technology Review

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Living with Technology: Trade-Offs in Paradise
Page 24

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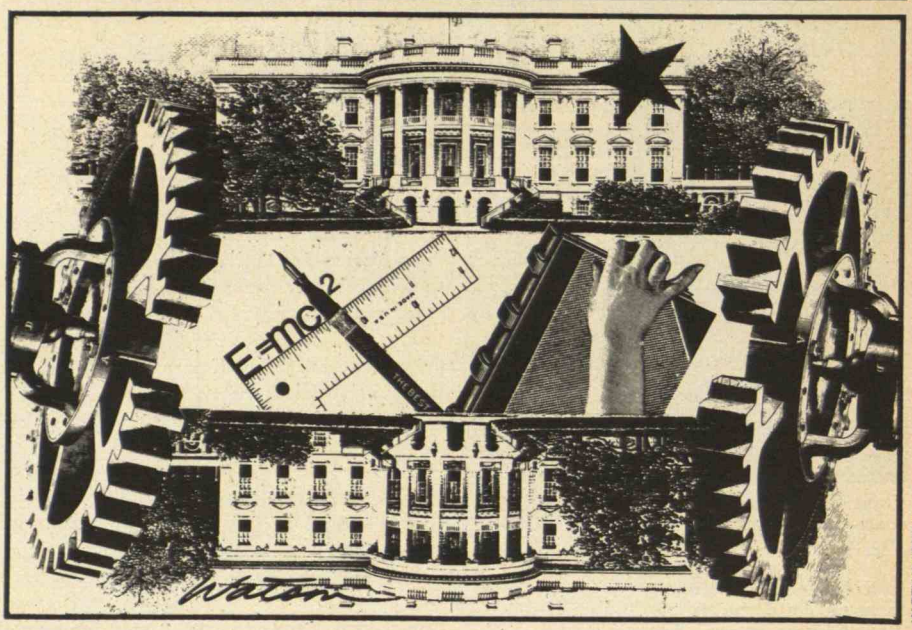

KAREN WATSON

On Science Policy Without Science

Science and technology have lost significant ground in Washington—and therefore the nation—during the first six months of Ronald Reagan's administration, and the country may soon come to regret it.

Whenever national commitments are reassessed and significantly changed, the pleas of special interests are shrill and often amplified, and basic needs are likely to be lost in the cacophony. In the present case, there is reason to fear that technology and the educational institutions that serve it are being seriously overlooked.

M.I.T.'s President Paul E. Gray raised three issues in his commencement address: federal assistance to science and engineering teaching at colleges and universities, support for science and engineering students (notably at the graduate level), and moves to constrain the international flow of technology. Robert C. Cowen (*page 8*) effectively summarizes these concerns. Suffice it to say that with technology flowering throughout the world, the United States can ill afford to reduce its commitment to the wellsprings of technology and isolate itself from the advances of other nations with a distorted, myopic view of its prowess.

However, one circumstance surrounding the new administration's approach has grave implications beyond the immediate issues: most of the new policy seems to have been made in ignorance of the arrangements painstakingly put in place during the last 40 years to provide counsel from the highest levels of the scientific community. These organizations, the National Science Foundation and the president's own Office of Science and Technology Policy, advise a nation whose future is deeply dependent on the vitality of its scientific and technological establishment.

Only tardily did the Reagan administration move to fill the post of White House science advisor and thus revitalize the Office of Science and Technology Policy. Before this, with essentially no input to the executive from the science and technology community, major changes affecting the choices among technological alternatives were incorporated into budgets for fiscal 1982. The basic problem is not that the science policymaking leadership of the last 40 years has been retired, though (as the viewpoints of the president of the influential Heritage Foundation [*see page 10*] reveal) that is a matter of grave concern. The real issue is that the wisdom of collaboration between science and government in this critical policy arena was so easily repudiated.

Jerome B. Wiesner, president emeritus of M.I.T. who was science advisor to President John F. Kennedy, summarized the situation last spring in a warning to Professor Frank Press, retiring from M.I.T. to become president of the National Academy of Sciences: "You will be dealing with a government that doesn't want advice that will get in the way of what it wants to do."—*J.M.*

LETTERS

Fishing Future

R.L. Edwards and J.B. Suomala, Jr. (*"World Fisheries in the Twenty-First Century," February/March, p. 42*) characterize today's fishing trawlers and gear as near-optimal and fishing style as random. Neither is generally true. New materials, innovative trawl-system designs, and a better understanding of fish behavior will continue to make possible both incremental and sweeping improvements in trawling efficiency. Trawl skippers combine precise navigation, sensitive fish detection equipment, and a cherished knowledge of where to fish based on season, weather conditions, time of day, tidal currents, and management quotas to maximize vessel profits—hardly a random process.

Before open ocean weirs can be seriously considered, the problem of how to haul aboard the corralled fish must be addressed. In addition, the energy embodied in these extensive weirs could significantly effect the total system efficiency. Proven passive techniques such as long lining, gill netting, and tub trawling seem more likely candidates for expansion on a purely energy-to-protein basis. Full catch utilization, sail-assist, improved brayton cycles, and coal-fired plants with high-technology aids will extend the practice of trawling far beyond the time frame suggested. To expect the fishing industry to abandon its preferred techniques while the rest of society proceeds as usual is illogical.
Cliff Goudey
Charlestown, Mass.

Mr. Goudey is an engineering consultant with Sea Otter Trawl Gear.—Ed.

Photovoltaics: Even in Chicago?

"Electricity Off the Roof" (*November/December 1980, p. 81*) would have been better titled "Electricity Off the Wall."

The peak demand for electricity in my house—for the air conditioner, range, and other appliances—is about 15 kilowatts on a hot summer day. If the cost per peak watt for electricity generated by photovoltaics is $1.60, the system required for my house would cost approximately $24,000; this compares very unfavorably with my annual electric bill (1980) of $1,400. Furthermore, I would require a rather massive battery for storing power against those times of cloudiness and darkness that "solar energists" seem to forget about.
Charles A. Licht
Olympia Fields, Ill.

Mr. Licht is president of Charles Licht Engineering Associates, Inc. Edward C. Kern, Jr., assistant group leader in energy systems engineering at the M.I.T. Lincoln Laboratory, responds:

The photovoltaic systems we are building are not designed to fulfill the maximum demand of a house; we propose to produce perhaps 75 percent of annual energy needs. We expect the utility grid to provide supplementary power when solar photovoltaic output is less than the house load; similarly, when solar output exceeds house load, the excess energy would be fed into the grid, purchased by the utility, and sold to other customers.

The purchase price for this excess energy would be related to the cost of fuel displaced, typically about half the current selling price of electricity based on the cost of capital equipment, personnel, and fuel. But if photovoltaic systems produce energy during hours of peak demand when utilities use expensive fuels and inefficient "peaking" generators, homeowners should receive a higher price.

Thus, the M.I.T. Energy Laboratory has concluded that electricity purchase prices for the utility will be from 50 to 80 percent of selling prices in systems in which photovoltaics contribute 20 percent or less of total electric load. If photovoltaics increase beyond that level, storage systems at a utilitywide scale, not in individual homes, will be required.

Mr. Licht's $1,400 electric bill is far above that of the average customer (6,673 kilowatt-hours at a total price of $341 in 1979) of his utility, Chicago's Commonwealth Edison Co. Our analyses indicate that reliable photovoltaic systems generating power for $1.60 per watt would be attractive to such average customers in 1986 in typical U.S. climates; this represents a cost of 8.5 cents per kilowatt-hour, compared with the 9.5 cents estimated for electricity generated by conventional means five years hence. Regrettably for Mr. Licht, Chicago ranks relatively low

among U.S. cities with respect to the amount of sunshine it receives; his price for photovoltaic electricity in 1986 may not be quite so favorable.

Stumbling in the Right Direction

Only through selective inattention (*"Continuity and Change: Thinking in New Ways about Large and Persistent Problems," February/March, p. 52*) could David Rose believe that his own partial solution to "the energy problem" brings us to "the forefront of the problem." In 1973, the Committee for a Better Environment published a series of articles through the Asbury Park Press proposing the same long-term strategy: reduced use of fossil fuels through energy efficiency and diversity of energy sources. But there is no consensus on the safety of the nuclear alternative, the role of subsidies, the need for regulation, and the choice between controlled and free-market pricing.

All experts resort to selective inattention and we must try harder to be self-critical. Rose is wrong when he writes that his proposed strategy "is quite different from what is being practiced." We have an oversupply of gasoline, and the United States has increased its energy efficiency by 12 percent since the 1973 oil embargo. As long as people pay attention to the facts of supply and demand and ignore the experts, we will continue to stumble in the right direction.

Martin B. Brilliant
Holmdel, N.J.

Professor Rose responds:

Mr. Brilliant's example of the Asbury Park Press series illuminates the problem: many people were saying the same general things in 1973 and earlier, and many detailed analyses of nuclear versus fossil-fuel options and the importance of conservation existed, albeit in more primitive form. But still the response does not measure up to the challenge. Most U.S. conservation measures, with the exception of the dramatic shift to smaller cars in 1980, incorporate little new technology and rather involve changes in patterns of use. While useful, much of this effort isn't what many people had in mind. The "oversupply" of gasoline could be wiped out in a short while if OPEC reduced its production by 2 million barrels per day, less than 10 percent of its production, possibly to the long-term benefit of some of its members.

Nature's Potential

I am confident that the biggest change as the proportion of managers who are also female increases will be the dissipation of fears and superstitions concerning "sex-linked characteristics" (*"Management in the 1980s" by Roy Amara, April, p.76*). Despite sensational popular-science articles, evidence overwhelmingly shows that nurture makes the individual out of Nature's potential.

Karen Furuhjelm
Nashua, N.H.

Effects of Petroleum Development

In "Fish versus Fuel: A Slippery Quandary" (*January, p. 68*), Robert Howarth states that the Offshore Ecology Investigation (OEI) conducted by Gulf Universities Research Consortium (GURC) "in no way proves that oil development is safe." GURC made no such claim; the primary conclusion of the OEI was that if cumulative effects of petroleum were present (they were not observed), they were obscured by natural variabilities that dominate the estuarine and offshore ecosystems.

A complete description of the OEI, its results, and the results of a detailed peer review of the data and an evaluation of its conclusions is presented in a *Rice University Studies* monograph, while the final OEI report is available on microfilm and has been widely distributed to federal agencies.

The OEI concluded that the coastal and offshore ecosystems studied were healthy despite more than 35 years of intensive petroleum development. This appears to establish that these ecosystems have a reasonable and practical tolerance of such activities. Unfortunately, GURC was afforded the luxury of only limited historical (baseline) data, a point of criticism in the article. For this and other reasons, we concur that the OEI findings do not constitute scientific proof that there are no adverse effects of any kind.

James M. Sharp
Houston, Tex.

Mr. Sharp is president of Gulf Universities Research Consortium. Dr. Howarth responds:

The individual investigators of the OEI wrote final reports of their work, and GURC then wrote and released the "Final Project Planning Council Consensus Report" in 1974. Neither the individual reports nor the consensus report were subjected to peer review, and the investigators' reports were long, detailed, and not readily available. However, the consensus report was widely circulated to politicians, government officials, the media, and others. The *Rice University Studies* monograph was not released until five years later, after GURC had received a great deal of criticism for the lack of peer review of their original reports.

The data collected by GURC totally fail to support the statement by Mr. Sharp and the writers of the consensus report that "the coastal and offshore ecosystems studied were healthy despite more than 35 years of intense petroleum development." The GURC studies compared the biota near rigs with other control sites and found few if any significant differences. Evidence strongly indicates that not only the rig sites but the control sites were polluted. One of the GURC investigators, Dr. Kritzler, con-

Continued on page 22

How Amoco uses an evolving science to help search for new oil and natural gas.

The earth science known as geochemistry is helping Amoco scientists determine the thermal maturity of organic matter in the earth's crust. Oil and natural gas can be present and discovered only in those regions where source beds have been properly matured with the correct ratios of heat and time.

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These techniques and others have aided Amoco in understanding the potential of discoveries such as those in the Overthrust Belt in Utah and Wyoming. Amoco is working in this science and others to provide the energy to keep America growing in the year 2000 and beyond.

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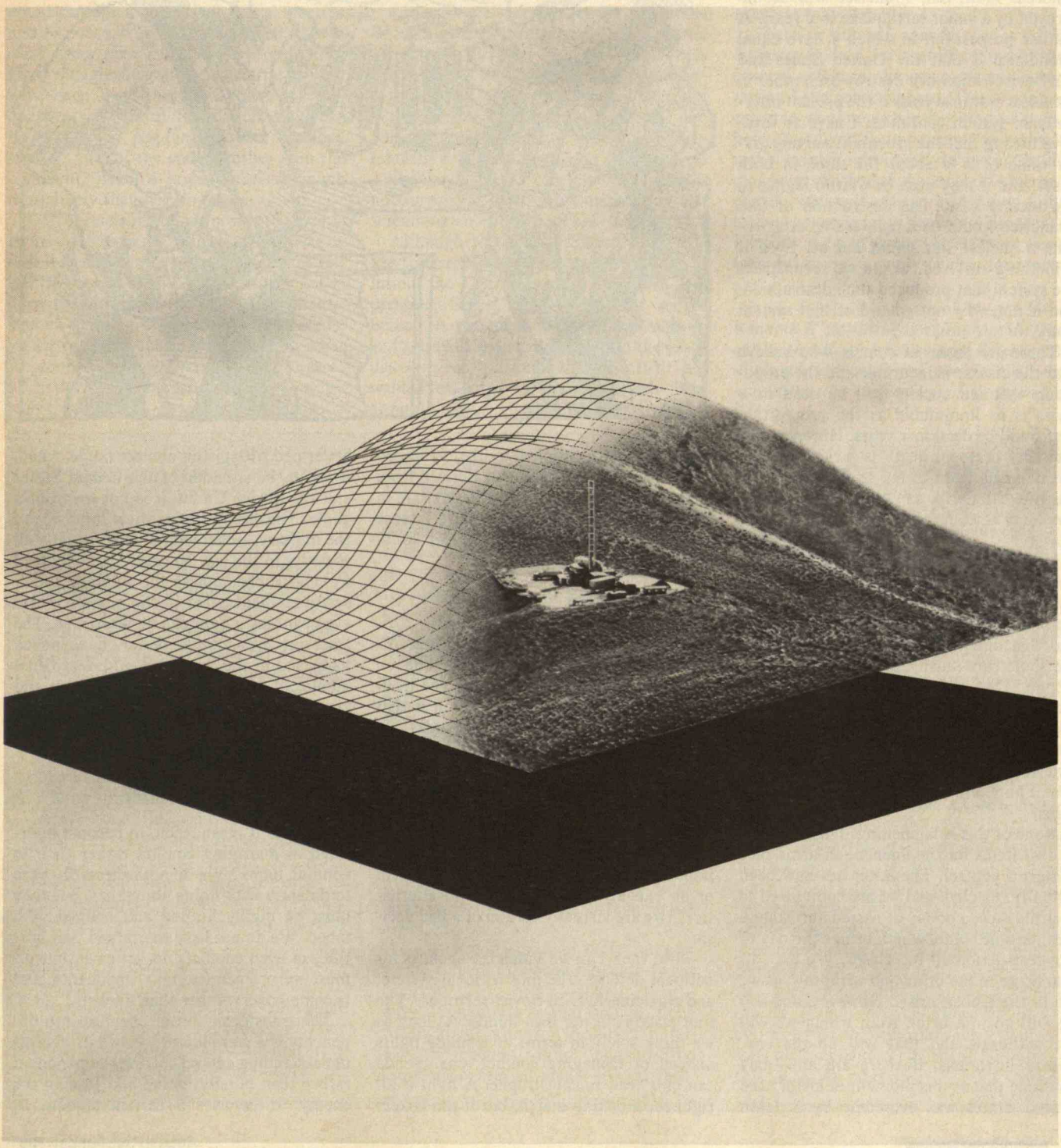


Kenneth Boulding

Survival at Gunpoint

ONE of the few predictions in which I have confidence is that unless some means can be found of lubricating the San Andreas fault, San Francisco will be destroyed by a major earthquake in x years. A similar proposition in which I have equal confidence is that the United States and the Soviet Union will destroy each other in a nuclear war in x years if the present international system continues. I have an intuitive feeling that the probability of any given value of x is about the same in both cases, and it may even be a little higher in the second case. The destruction of San Francisco would be a recoverable catastrophe; a nuclear war might not be. Even if something survived, would we reconstruct the system that produced such destruction, and if not, why not get rid of that system now?

There are those of course, who believe that the disease is incurable and the proposition that our society will be dead in x years is as immutable as the proposition that I will be dead in x years. However, the fact that personal death is inevitable does not deter us from trying to prolong vigorous life. Similarly, one prefers that society not die of certain things, one being a nuclear war.

Under these circumstances it is amazing that the belief in national defense and stable deterrence continues when it is clear that national defense can no longer defend and that deterrence, while it can deter in the short run, must lead to eventual catastrophe. One would expect that a great intellectual effort would be made to widen decision-making agendas, explore every possible alternative future, and make a renewed effort to understand the complexities of human behavior under conditions of threat.

None of this is happening. There used to be two items on the agenda, an arms race and arms control. The latter has now been virtually rejected, and we are committed to an arms race, a policy of hatred abroad and meanness at home, which brings the day of our destruction all the closer. We may, of course, go to the brink and withdraw, as we did in the Cuban crisis. However, one day we will go to a brink from which we will not withdraw and that will be the end. Future historians, if there are any, may conclude that at this moment in history the United States was overcome by a death wish, perhaps occasioned by the childhood trauma and Oedipus complex derived from a history of revolution. The Russians are in exactly the same or an even more intense version of the same psychological situation.

Managing Conflict

Nevertheless, there are agendas and futures different from the suicidal one on which we seem to have decided. The trouble with having made any decision is that we stop thinking about further agendas. No decision should be regarded as final, and the search for agendas should always continue. One suspects it is the lack of agendas rather than a defect of our choices among them that is the major source of bad decisions. When the agenda is reduced to one item and the chooser, whether a politician or an executive, says "I have no alternative," we are virtually certain of a bad decision.

How, then, can we widen the agendas for national defense, the international system, and particularly U.S.-Soviet relations? The first place is in our own minds. As long as we think solely in terms of winning fights instead of managing conflict, our agenda can only lead to catastrophe. A fight is all right for a boxing match, but if the boxers are armed with pistols at close range, which is about the situation of the United States and the Soviet Union, it is not much of a game. The rise in the political influence of the military, a characteristic of virtually all societies in the last 30 years, can only lead to catastrophe, unless the military themselves recognize that in the modern world even winning a fight can be disastrous. The loser may even emerge better off, as indeed happened in the Second World War. Economically, the military losers, Japan and Germany, won simply because they lost their own military, the greatest enemy of almost any country.

Empathizing with the Enemy

What does it mean, then, to become interested in managing conflict rather than in winning fights? We do not necessarily have to do away with fights altogether, but they must be highly limited and hedged with taboo. We do not have to pretend that hostility or even conflicts do not exist, but we must turn enemies into opponents and become boxers rather than duelists.

The transformation of enemies into opponents is a complex process that involves understanding and respecting the opponent rather than blindly hating and fearing the enemy. It involves a certain amount of

empathy, ironically a very important skill in winning fights. Indeed, there is a strong tendency for those who win fights to predict what the opponents will do in a complex situation, whether this is boxing, football, chess, or battle.

Sometimes this change in attitude may be effected by some higher authority accepted by both parties. Sometimes it comes about through a process of mutual reaction and response, what might be called a "negative arms race," initiated by one party. Even though such attempts at arms control have been frustrated so far by an inadequate psychological foundation, they can be practiced. As long as the ideology remains that of the enemy rather than the opponent, positive arms races are much more likely than negative ones.

One obstacle in getting people to think in terms of opponents instead of enemies is that it is not clear what actions should follow. We know what to do with enemies—develop hatred, fear, and build up threats. But in thinking of enemies as opponents, we are forced to consider more deeply what the conflict is about. In particular, we have to understand how threats affect those whose behavior is governed by a neurotic tendency. Both the United States and the Soviet Union are alcoholics, each pursuing a form of destructive behavior driven by a neurotic compulsion. Perhaps the first step toward understanding one's own neurosis is an attempt to understand the opponent's neurosis. The trouble is that each country projects its neurosis onto the opponent, whereas each may have different sources.

For example, one can hardly blame the Soviet Union for being excessively neurotic about security when its "childhood trauma" includes 400 years of intolerable Tartar rule, its adolescent trauma includes Napoleon's and Hitler's invasions, and when it now feels caught in a vise between a hostile China and a hostile West. Russia is like the donkey between two skunks; it is not surprising that it ends up kicking and screaming and biting Afghanistan.

Although the United States has had a less traumatic history, it did have the Revolution, the Civil War, and the Great Depression. Since 1870, it has felt secure behind its two great moats of the Atlantic and the Pacific, and that it made the great discovery of freedom. As a result, it has wanted to be loved, and rejections from around the world have been deeply painful.

However, an agenda of conflict management is quite feasible, though one can never guarantee success: there always has to be luck. We were lucky to have Eisenhower and Khrushchev, two country boys raised to political power who had some sympathy with each other. Now we have a cowboy facing a dotard sheriff. But good luck may come again, and the idea of conflict management may spread.

There is still one agenda that is so far from anybody's list that it seems almost absurd: unilateral disarmament and acceptance of the consequences. This is such an extreme and uncertain position that nobody has given it any serious thought. It would involve a profound change in the ideology and attitude of the mass of American people, who still believe in winning fights rather than managing conflict. This scenario needs to be explored seriously: it might turn out to be our only chance for survival. □

Kenneth E. Boulding is a program director at the Institute of Behavioral Science and distinguished professor emeritus of economics at the University of Colorado at Boulder.

Removing the Weapon

by Steven J. Marcus

To be caught in the neighborhood of a nuclear reactor meltdown would be unpleasant and a long-term threat to your health. To be victimized by an exploding nuclear weapon would be considerably more unpleasant—although the agony would be brief—and just about as unhealthy a situation as could possibly occur. There's only one thing worse: to be near a nuclear power plant being hit by a nuclear weapon.

Why study such a seemingly academic, worst-case scenario? Because it is a poignant reminder of the modern world's vulnerability to nuclear weapons, say Dr. Kosta Tsipis (director of the Program in Science and Technology for International Security at M.I.T.) and his student Steven Fetter. As they observe in their recent report "Catastrophic Nuclear Radiation Releases," "A determined or desperate combatant can, by waiting for the proper weather conditions, devastate a substantial fraction of the industrial capacity of an opponent with a single nuclear weapon aimed at a reactor."

Although the number of immediate casualties from the nuclear-weapon/nuclear-reactor combination would not be appreciably worse than those from the weapon alone (a "ground burst"), the long-term difference would be substantial. "The reactor nuclide inventory has a decay rate much slower than that of the bomb debris," observe Tsipis and Fetter, so that "a month after the explosion [of a one-megaton weapon on a one-gigawatt reactor], the area that remains uninhabitable is three times larger, and after one year ten times larger . . . as compared to a simple ground-weapon detonation." All in all, they calculate, the "cumulative losses" (uninhabitable land, measured in square-mile years) would be "40 times greater than the damage caused by a surface burst alone."

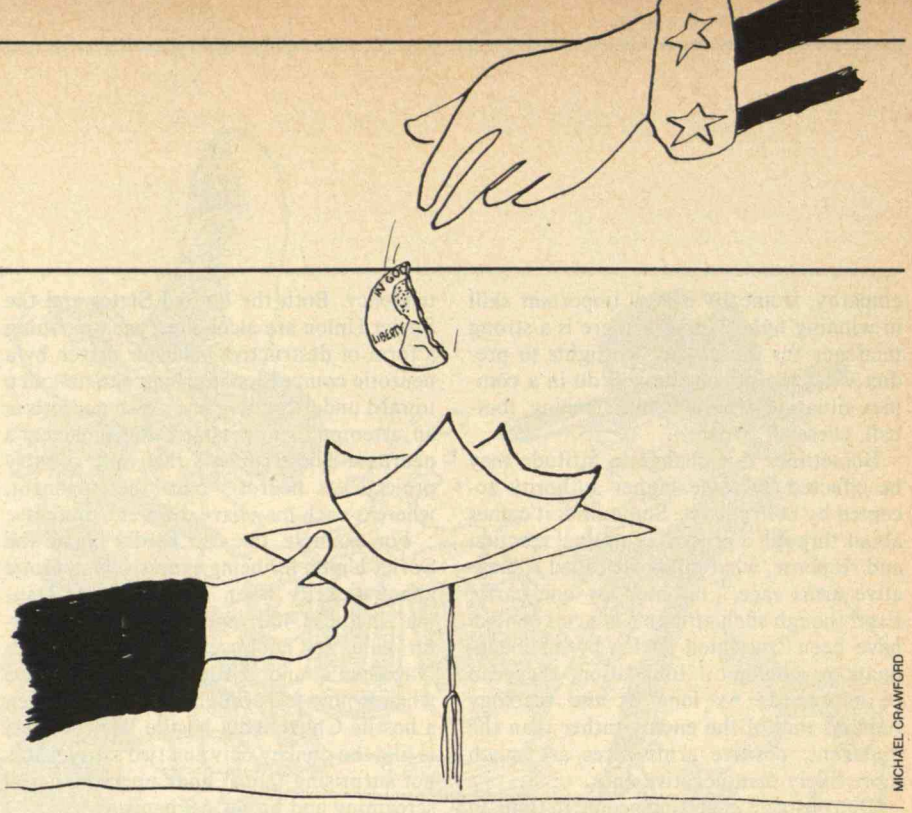
So what do Tsipis and Fetter suggest we do to avoid this contingency—what they call a "totally unacceptable eventuality"? There are several options, none practical, for removing the target: eliminate the nuclear reactor industry (too late); dismantle all above-ground reactors and rebuild them underground (too expensive); or negotiate to place reactors off-limits in the event of war (too improbable). A more sensible route, they claim, is to remove the weapon: "If a single conclusion were to be drawn from this report, it must be that a single nuclear weapon detonation on the ground generates radioactive fallout many times more intense and contaminates much broader areas than the worst conceivable nuclear reactor accident." Thus, they assert, "the relatively intense preoccupation of the general public with the risks presented by nuclear power plants, as compared to the risks inherent in a nuclear war, appears misplaced."

This is not the first time that arms-control analysts, in their well-intentioned efforts to sensitize the public, have essentially minimized the need for public concern about nuclear power plants and other technologies of high perceived risk. Their goal is to emphasize the considerably greater risk, and impact, of nuclear war. However, is it politically or scientifically sound to dismiss all problems other than the num-

Continued on page 16

Robert Cowen

Federal R&D: Let Them Eat Seedcorn



"FROM the cyclotrons of Berkeley to the labs of M.I.T., we're the lads that you can trust to keep our country strong and free." So sang a platoon of white-coated physicists in a cartoon that mirrored the United States' mood of the late 1950s. A bold thrust into space by the Soviet Union had shocked the American public, which now looked to basic research and science and engineering education to revitalize our technological prowess and strengthen our security. Nearly a quarter of a century later, the public seems to have lost that faith. How else to explain the actions of an administration, purportedly committed to strengthening U.S. technology and defense, which nonetheless chokes off badly needed funding for relevant education and continues regulations that hamstring research in universities? How else to account for the apparent acquiescence of Congress?

The situation has become so alarming that scientific leaders and university administrators talk in terms of "crisis" and "threats to national security." Indeed, M.I.T. President Paul E. Gray devoted most of his commencement address last June 1 to the subject. Noting that great research universities are "fragile," he warned that "it takes forever to create them and but a moment to lose them." The danger of eroding their effectiveness—if not of losing them outright—is very real.

The U.S. scientific and engineering community accepts the fact that it must bear a fair share of federal budget trims. However, it is widely believed that the elimination or severe curtailment of National Science Foundation (NSF) support for science education and social, behavioral, and economic sciences could damage our scientific and technological strength out of all proportion to the amount of money saved. This concern is heightened by the perception that the cutbacks reflect ignorance of the crucial role of science education and an ideological distaste for "soft" science.

The physical and biological sciences actually fare moderately well under the Reagan budget. But the NSF's educational program would be phased out and support for graduate fellowships eliminated. Educational funds would be cut from about $70 million in fiscal 1981 to $10 million in fiscal 1982, leaving just enough to cover existing fellowship commitments. A $75-million program to help universities upgrade antiquated teaching equipment would also be eliminated. Plans to help women and minorities enter science and engineering would be scrapped.

The administration argues that the NSF program is encompassed by the far larger educational commitments of other agencies and that its function would be better left to states and local communities. However, nothing could fill the role of the NSF as a catalyst for upgrading science education at precollege and university levels.

"To expect scientific and technological progress while abandoning efforts at improving science and technological teaching in our schools is illogical and a disservice to the nation's interests," Allan Bromley, president of the American Association for the Advancement of Science (AAAS), has warned. Such a course "would deal a severe setback to U.S. science and technology and to the country's industrial, commercial, and military strengths," say the directors of the American Chemical Society.

The fact that the budget decisions were made without competent scientific or engineering advice sharpens the concern of the scientific community. The NSF budget was revamped before the post of White House science advisor had been filled and without consulting the National Science Board, a 24-member citizen group that, with the director, legally constitutes the foundation.

Even more galling is the prejudice against social and economic sciences, to say nothing of the humanities, which some see as a reaction against "soft" sciences that provide some of the data used to promote social programs. William D. Carey, AAAS executive officer, summed up this concern in *Science*: "For the first time in the postwar partnership of science with government, summary judgment has been passed on the legitimacy of particular fields of scientific inquiry without the benefit of due process. The social and economic sciences have been scored as flunking tests of need and worth on the scale of government fiscal values. . . . Isolating the social and economic sciences means inflicting damage on the integrity of all scholarship."

Cutting the Schools That Feed Us

Special concern is felt by engineering educators. As Courtland D. Perkins, president of the National Academy of Engineering, says, "The defense of the country and its economic growth are both endangered by the decline in available engineering talent resulting from serious problems . . . in our engineering education programs."

Broadly speaking, the problem shows up as a precipitous drop in graduate engineering enrollments. Although the United States still turns out many high-quality engineers at the bachelor level, as many as half of all graduate students are foreign nationals who will return home. The United States simply is not educating the people it needs to fill engineering faculty positions, a number of which already go begging. This could result in a serious shortage of bachelor-level engineers as early as 1985. Potential graduate students are being attracted to industry by high salaries and the implication that industry is where the action is. With graduate stipends cut and aging equipment in universities, industry will in the future seem even more to be the best channel for career growth.

President Gray warned in his address

that we are in danger of "eating our seed-corn." Referring to the loss of funding for new instrumentation, he added, "The abandonment of long-delayed, desperately needed initiatives for equipment and facilities renewal, as well as other possible cuts in funding for university-based research in the sciences and engineering—to say nothing of the humanities and the arts—could quickly erode . . . this country's research enterprise. Since the late 1960s, there has been scant attention paid to the capital base of the research universities . . . and this neglect seems likely to continue. Its effects, like those of dry rot, may remain hidden for a few more years, but they are real and palpable."

Only slightly less worrying than the funding picture is the regulatory grip now hampering universities. The Office of Management and Budget (OMB) A-21 directive is particularly galling. This requires university scientists and engineers to account in detail for 100 percent of their time, whether or not they are supported full-time by federal funds. Strictly enforced, it could require federal permission for a leave of absence. As *EOS*, the transactions of the American Geophysical Union, has reported: "The confirmation of senseless concepts, such as percent of effort (would a professor have to account for his thoughts?), and impossible rules (professors often teach, do research, administrate, etc., all at the same time—and after normal working hours) have led to a sort of cynical compliance. . . . Because the activity breakdowns often cannot be done as required, compliance becomes fabrication."

The National Academy of Sciences joins a number of university presidents in pressuring OMB to reconsider A-21. Although OMB has allowed some postponement while alternatives are considered, the directive has so far stood firm.

More ominous are moves by the Departments of Commerce and Defense to extend the International Traffic in Arms Regulations and the Commerce Department's Export Administrative Regulations to broad areas of unclassified university research. These regulations are aimed at restricting exports of commercially or militarily valuable technology, but now there are moves to apply them so broadly that they could choke free enquiry. Dr. Gray notes, "In the broad scientific and technical areas defined by the regulations, faculty could not conduct lectures with foreign students present, they could not exchange information with foreign visitors, they could not present papers or participate in discussions at conferences where foreign nationals were present; they could not publish research findings in the open literature. . . . Those who would circumscribe the free exchange of ideas among scientists and scholars in the name of protecting this country's technological lead would, on the contrary, inflict severe damage on the very system responsible for creating that lead."

This foolish action cannot be attributed to President Reagan; both A-21 and the extending of export controls began under President Carter. However, the present administration has been unresponsive to pleas for redress. A letter of protest sent by the presidents of the California Institute of Technology, the University of California at Berkeley, Cornell University, Stanford University, and M.I.T. last winter has so far merely been acknowledged.

Going to the Constituency

It would be easy to blame misguided politicians for the danger that universities now face, but I think the problem runs deeper. The actions of the Reagan administration and Congress reflect a general public mood in which the connection between basic research, education, and technology has been forgotten.

This was apparent when a group of experts, including six Nobel laureates, asked the House Budget Committee for more research money. Robert L. Livingston (R) of Louisiana, pointing out that a "drastically different" political climate now demands fiscal restraint, suggested that scientists set research priorities. However, the group's position paper insisted that "the problem cannot be solved by redistributing limited funds. Additional appropriations are clearly needed." This obviously didn't sit well with David R. Obey (D) of Wisconsin, who told the scientists, "You have a political problem. You are not going to win it here until you win it [out] there."

That, indeed, may be the wisest comment on the whole issue. While scientists can lobby Congress and the administration, reaching out to the public at large may be even more important. Concerned university administrators and faculty members have a lot of speech making, article writing, and TV lobbying to do. □

Robert C. Cowen is science editor of the Christian Science Monitor *and former president of the National Association of Science Writers. He holds S.B. and S.M. degrees in meteorology from M.I.T.*

The War on Entrepreneurs

by David G. Soergel

DURING fiscal 1981, the government will spend $14 billion trying to solve important national problems it has no business solving. This federally monopolized research and development capital will be spent bringing civilian technologies—such as synfuels and less-polluting manufacturing processes—to production. Similar past efforts gave us a supersonic transport that never flew, new-technology houses that never found a market, and a standard city bus that no manufacturer thought worthwhile to produce.

The funding of such ideas is politicized by congressional committees and bureaucratized by government R&D agencies. The "seed" money to explore and develop them will mainly be spent by some 800 nonprofit public and private technical organizations employing 105,000 scientists and engineers. Because these organizations don't produce what they develop, they have no final accountability for the projects. Moreover, U.S. tax, procurement, and R&D policies combine to form an implicit "national anti-enterprise" policy that immunizes government-approved R&D programs against the challenge of competitive ideas and innovations from the private sector.

This growing government control over seed capital, combined with high marginal tax rates on interest and investment income, have nearly put America's entrepreneurs out of the business of going into business. Thus, to revive our economy we need not only major tax cuts, especially for individuals, but also elimination of nearly half of the federal R&D budget.

One reason the economy has deteriorated is that our $14 billion of civilian R&D is managed in the same way as our $21 billion defense (and NASA) R&D budget. Apparently, members of Congress expediently think that because weapons R&D policy successfully put people on the moon, they ought to follow the same policy in putting up better housing and developing automobiles that use less gas and emit fewer pollutants. But weapons R&D methods are wholly inappropriate to other national goals.

There is a good reason why U.S. taxpayers rather than private investors pay the costs and take the risks of new weapons development. Such developments are aimed at single-buyer markets and thus are less attractive to private investors than developments aimed at multiple-buyer markets. Loss of a single-buyer market means more than a lost sale; it could mean going out of business, particularly for an emerging enterprise. These investments are even less attractive when the developments are high-risk, costly weapons such as F-16 fighter planes or B-1 bombers purchased only by the government. Under these conditions, government has no choice but to tax all income earners for weapons seed capital and to attract Yankee ingenuity to the defense industry.

Other features of weapons R&D policy are also lacking in private capital markets. For example, profits may be earned right from the beginning of contracted weapons R&D activity. If the project is cancelled before production for reasons that do not involve the contractor (as with the B-1 bomber), the contractor still retains the R&D profits. Weapons contractors may also indirectly charge to current contracts the costs for researching altogether new

Taking Government Out of Technology

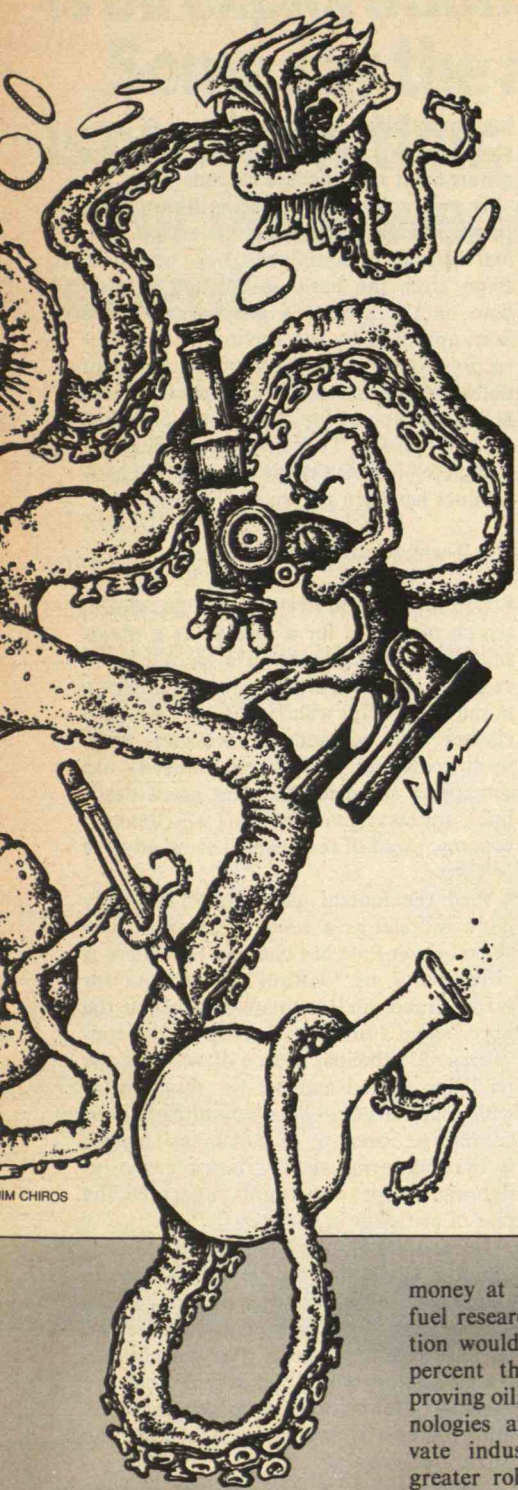
by Edwin J. Feulner, Jr.

FOR the past few decades the scientific community has pondered how to reduce the paperwork and regulations associated with government-funded research and development, how to facilitate the flow of scientific advice to the Executive Branch, and how to cope with the serious obsolescence of the tools of research in universities.

Scientists have also recently expressed a number of new concerns: Will fiscal austerity eliminate the basic research that is essential to the long-term strength of our economy as well as our leadership position in science and technology? Can private enterprise efficiently manage space, defense, and energy research that requires coordination and pooling of resources on a national scale? Will private enterprise undertake the basic research required to develop low-profit products such as drugs for rare diseases? This debate has taken on renewed significance as a conservative president and Congress have assumed the reins of power in Washington.

The Reagan administration's proposed budget for fiscal 1982 would increase NASA's appropriation by $6.2 billion but would earmark most of this for the space shuttle program; funds for the development of exotic forms of propulsion and other ambitious projects such as a proposed mission to make radar images of Venus would be reduced. Large federal outlays for astronaut space flight can be expected to continue because of the significant implications for national security.

Administration officials also want to eliminate subsidies for the several major synthetic-fuel projects supported by the Department of Energy



IM CHIROS

weapons even before the contracted weapon reaches production.

Perhaps most unusual and attractive are the financial instruments used to implement weapons R&D policy. Unlike Wall Street's venture capitalists, the government does not demand equity stocks, bonds, or commercial loans in exchange for R&D contracts and grants.

All these unmatchable factors drive private investors out of markets controlled by the government and leave entrepreneurs with the sole choice of federal financing. But even entry costs into federal R&D markets are unaffordable because government's procurement system is a Catch-22 requiring entrepreneurs to first prove what they propose to prove. Moreover, while established contractors can charge their tax-deductible expenses for new federal business to current contracts, entrepreneurs must draw from their personal after-tax equities to advance their ideas to federal contract proposals; most go broke if they are foolish enough to try. Consequently, weapons R&D policy, with the help of the tax system, tends to concentrate any industry (such as aerospace) to which it is applied.

Then there is the immunized single choice that comes from federal R&D, unavoidable for weapons since government is the sole buyer but entirely unsuitable for ordinary people who must buy what they can afford to meet their daily needs. Short of a massive cloning of Americans, weapons R&D policy cannot accommodate the vast diversity in the needs and means of all consumers.

After three decades of experience we ought to know better. The aborted SST was governed by weapons R&D policy. Project Breakthrough, the aborted housing technology program, was governed by weapons R&D policy. So was the abandoned, government-designed city bus. And in waging the "moral equivalent of war" to gain energy independence, we have applied weapons R&D policy to developing supposedly competitive options such as synfuels, biomass, solar energy systems, and, of course, nuclear power. But proven failures and noncompetitive solutions have made little difference. Ignoring Santayana's advice about repeating the past, the Department of Transportation recently launched a monopolized, 10-year, billion-dollar program in automotive technology.

We must stop applying weapons R&D policy to nondefense national goals if capitalist enterprise is to survive in America. By restoring the $14 billion in federal R&D funds to private capital markets, we can markedly improve the startup and survival chances of new, innovative enterprises. Major tax reforms increasing the investment capital available to our nation's risk takers are also required. Even with these reforms, an important challenge would still face the Reagan administration: to institute a new entrepreneurial policy that will motivate the private interests of investors, developers, and consumers toward the achievement of public goals. □

David G. Soergel is president of DGS Associates, a public-policy research firm in Potomac, Md. He has been extensively involved in the aerospace industry and from 1970 to 1973 was a member of the U.S. Commission on Government Procurement.

and transfer them to the government-controlled Synthetic Fuels Corp., which may or may not provide loan guarantees or other aid. Under this new approach, private companies would manage construction and put more of their own money at risk. As for fossil-fuel research, the administration would like to cut by 45 percent the outlays for improving oil, coal, and gas technologies and encourage private industry to assume a greater role. The budget for these purposes has increased by a factor of more than 15 since 1974 even as support from private corporations has increased.

The National Science Foundation's program in the "hard" sciences, such as physics and biology, would be left almost intact, but the administration would like to substantially reduce NSF programs in "soft" disciplines such as economics, psychology, and sociology, thus restoring the science agency to its original purpose. Particularly affected would be requirements enacted by Congress and previous administrations requiring the NSF to promote various social goals far afield from the production of knowledge. These include encouraging women and minorities to study mathematics, engineering, and the sciences, encouraging innovation in small businesses, and urging scientists in states receiving less than their share of federal support to apply for federal grants.

These proposals have created concern and even dismay. Perhaps we have become so accustomed to federal intervention in our university research centers and industrial laboratories that we cannot imagine functioning, much less excelling, without it. Like teenagers who suddenly find

Continued on next page

themselves cut off from Dad's wallet upon reaching age 18, we wonder, "Is there life after budget cuts?"

If the only thing conservatives in Washington could do was cut budgets, the answer might be debatable, but in this case the prognosis is excellent. Conservatives are not anxious to create a vacuum within the scientific sphere and therefore are proposing alternative means of funding research and development. I believe that in this as in so many other areas, the free market will be the best allocator of resources.

Although the federal government can be criticized for having too short a time horizon when it funds and evaluates research, no scientist is likely to accuse it of being too hasty. Before any federal funds are spent on a project, the authorizing agency is likely to have spent several hundred thousand dollars and several years studying its feasibility.

In stark contrast, one of the greatest strengths of free enterprise is its uncanny ability to respond to material and technological needs in energetic and timely fashion. Let physicians express a need for sophisticated medical equipment or the public articulate a desire for more fuel-efficient housing and private industry is quickly at work on the appropriate products.

Granted, there is no guarantee that private industry will apply this remarkable ability to solving problems that may require years of research, yet a lengthened time horizon and a quick response are not incompatible. The challenge is to make research and development with long-term remunerative benefits attractive to private industry today, and to make endeavors with faster payoffs even more attractive.

One proposal now being studied by Milton R. Copulos, energy analyst at the Heritage Foundation, is the possibility of giving corporations a ten-year tax exemption on the profits from commercialization of patent inventions. Mr. Copulos points out that the technological revolution of the late 1880s blossomed under a system in which the only form of federal revenue was tariffs; there was no income tax to discourage invention and entrepreneurship. If "Silicon Valley" industries could mushroom in Southern California in recent years despite high corporate income taxes, imagine the multitude of ventures likely to be launched if profits are tax-exempt for ten years!

The space program of the 1960s and 1970s profitably transformed a few innovations to commercial success—Tang breakfast drink, computer microchips, and Teflon and other synthetic materials. Yet a "veritable gold mine of ideas and technologies has never been released to the private sector," according to Mr. Copulos. He proposes instituting a centralized index of technologies developed at taxpayer expense to license these innovations to commercial firms, with the proceeds used to defray the cost of maintaining the center and provide capital for further research and development.

What about research with no commercial value? Some particularly intriguing—almost radical—proposals are made by Richard Speier in the Heritage Foundation's analysis of the federal budget from a free-market perspective, *Agenda for Progress: Examining Federal Spending*. Mr. Speier examines research activities without practical benefits—for example, NASA's exploration of the solar system and the universe, the astronomy activities of the NSF, and the high-energy physics program of the Department of Energy. This category also includes research with potential beneficiaries so uncertain that we cannot identify commercial interests.

Because the long-term benefits of such research are not confined to the United States, Mr. Speier suggests that funding should be based on international cost-sharing. For example, he writes, "Is it necessary for the United States alone to fund the positron electron project 'to keep its forefront physics research program highly competitive with comparable European facilities'? Why not share the funding of and access to this research with, for example, the Japanese, who have no comparable program? Indeed, why not invite into the funding process some of the OPEC nations, who can thereby invest in a commodity that cannot be expropriated—knowledge?

"Many of the 'big science' projects most suitable for cost-sharing exhibit economies of scale; by modifying the hardware, twice as many experiments may be done with a given high-energy physics facility or space exploration instrument at less than twice the cost. Consequently, the researchers of many nations can gain more knowledge per dollar by pooling their research activities." Indeed, international cost-sharing could work both ways: the United States could buy into foreign projects, too, especially if economies of scale are possible.

The private sector will never become science's primary support as long as the federal government uses its extraordinary regulatory, taxing, and judicial powers to discourage the commercial application of the fruits of the discovery process. Indeed, the technological and economic risks confronting potential entrepreneurs are often overshadowed by uncertainties for which the government must accept responsibility.

It now costs $10 to $15 million over a period of eight to ten years to develop, test, and register a completely new pesticide. Even after the basic safety and efficacy data on the product's primary use have been approved by the Environmental Protection Agency, hundreds of thousands of dollars may be needed to generate additional data to support use of the same chemical on other crops. This investment must be completed before a single pound of the new product has been put on the market.

Our Technological Response

Scientists who toil tirelessly for decades in search of a cure for a disease or a major scientific breakthrough are perhaps the most far-sighted and future-oriented group in the nation. But when laboratory idealism clashes with bureaucratic pressure, long-term goals and professional integrity are sometimes sacrificed to meet grant deadlines, appease agency officials who demand concrete proof of results, and avoid adverse publicity.

And the federal government is hardly more rational as a research sponsor. The *Washington Post* has charged that there is an epidemic of "wiffum" (shorthand for waste, fraud, and mismanagement) in the government's funding of research and consulting. A principal source of waste is the tendency to end support for research, to which millions of dollars have already been committed, because of personnel changes in the sponsoring agency, bureaucratic infighting, budget constraints, and even the fear of criticism in the press.

In another example, the government overstimulated the production of doctors and scientists in the 1960s and 1970s despite contrary demographic trends. Richard Speier suggests that the nation's research effort would not suffer if science agencies allowed market forces to determine the who, where, and how of scientific career decisions.

Conservatives believe that the private sector, given the proper incentives, is fully capable of funding scientific research and innovation. An essential element is the simple measure of getting government "out of the way" of those who are willing and able to support scientific progress. □

Edwin J. Feulner, Jr., is president of the Heritage Foundation, a Washington-based public-policy research institute.

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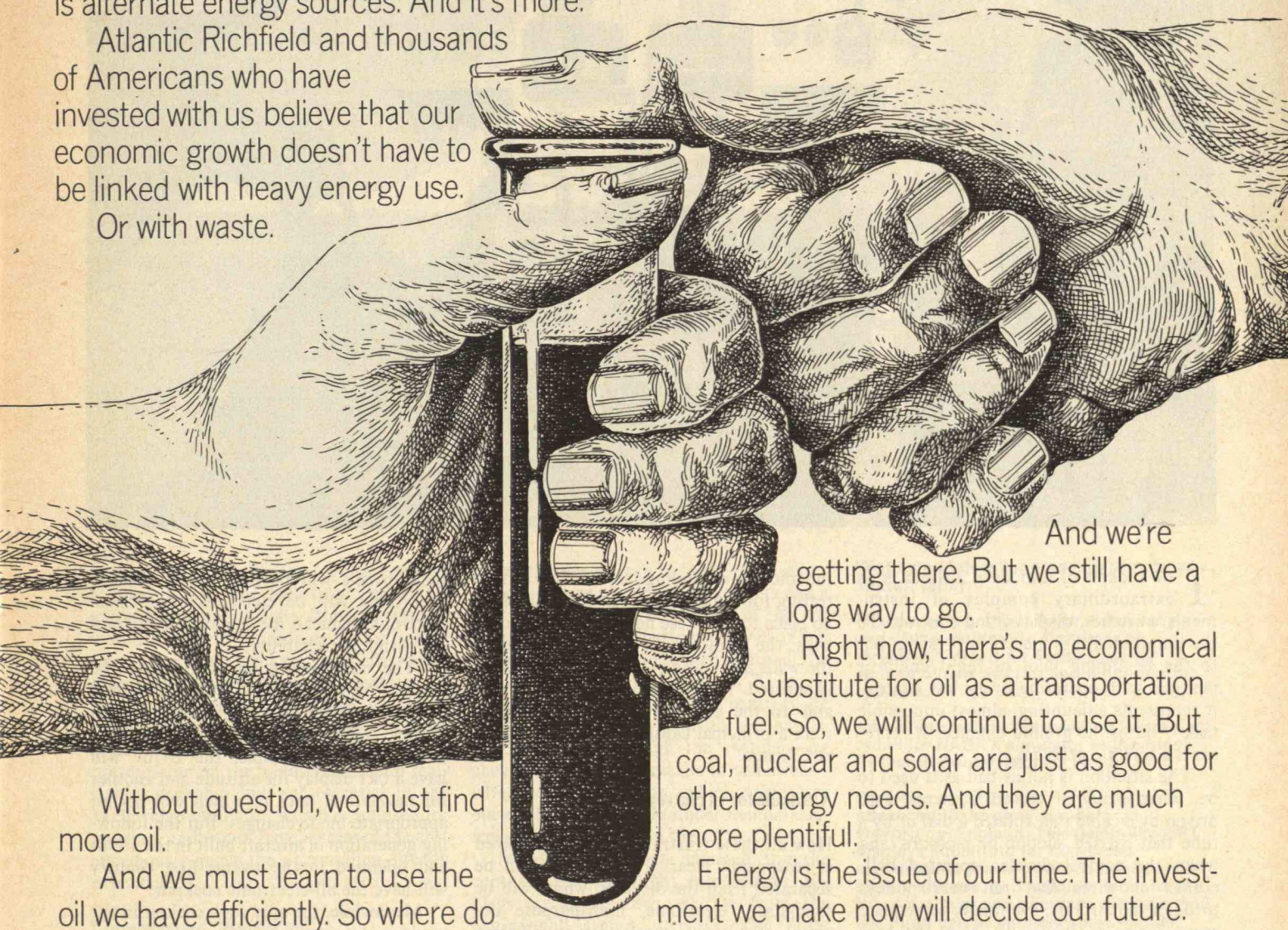

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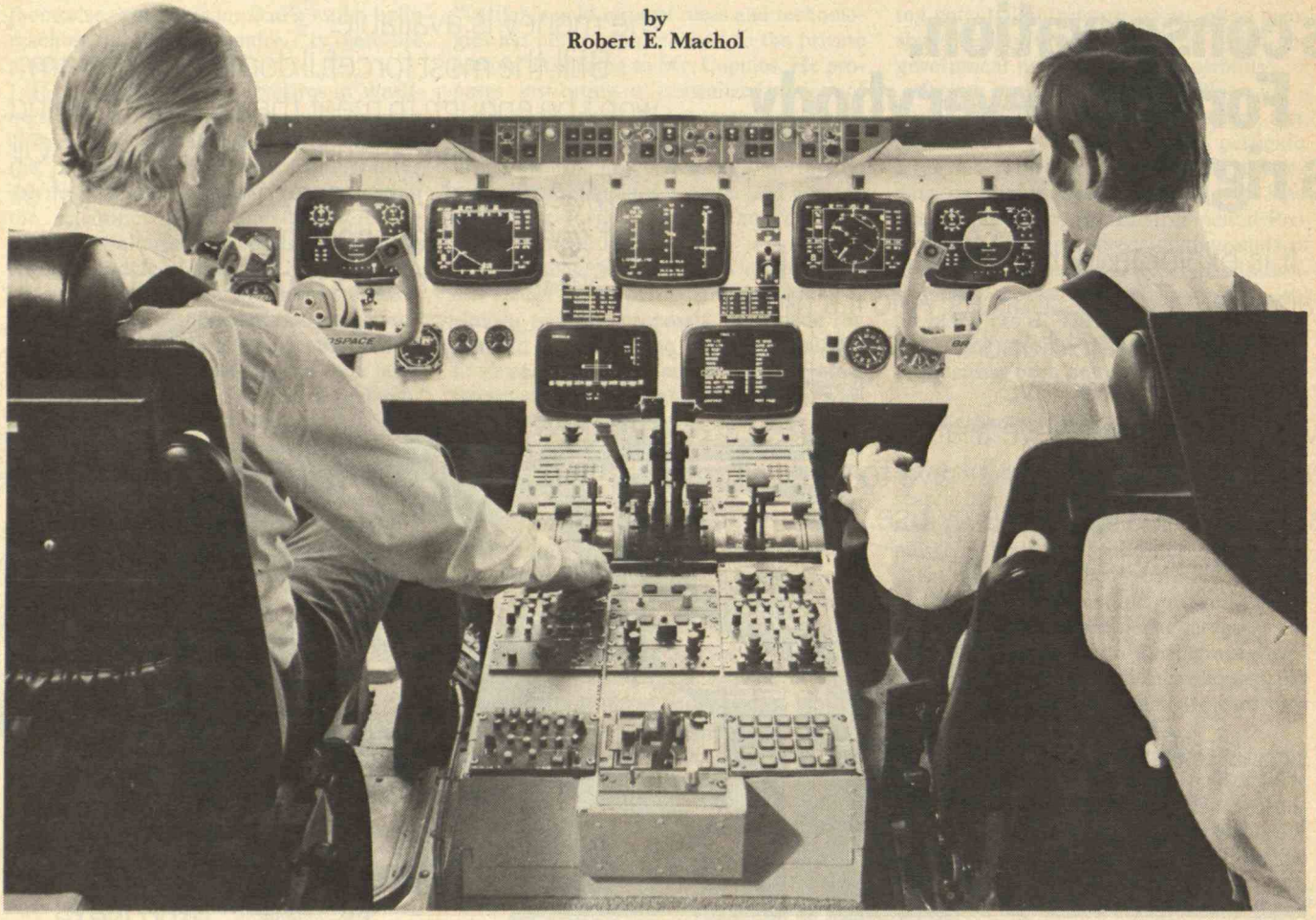
The Cockpit of the Future

by
Robert E. Machol



THE cockpit of a modern airliner is an extraordinary complex of instruments, switches, displays, and controls. To the uninitiated it is merely impressive, but to the beginning pilot or flight engineer charged with operating every last control, it represents a daunting, almost impossible task. And to the ground engineer it represents a terrible problem.

The situation is not as bad as it used to be, when many of the instruments were driven by a cable that rotated a dial or by a tube that carried suction or pressure, and when the control devices operated bellcranks or wires that ran over pulleys through the aircraft, eventually to activate some device mechanically. Now the controls are generally hydraulic and instruments electrical, but this still leads to an impenetrable maze of wires and hydraulic tubes behind the panel.

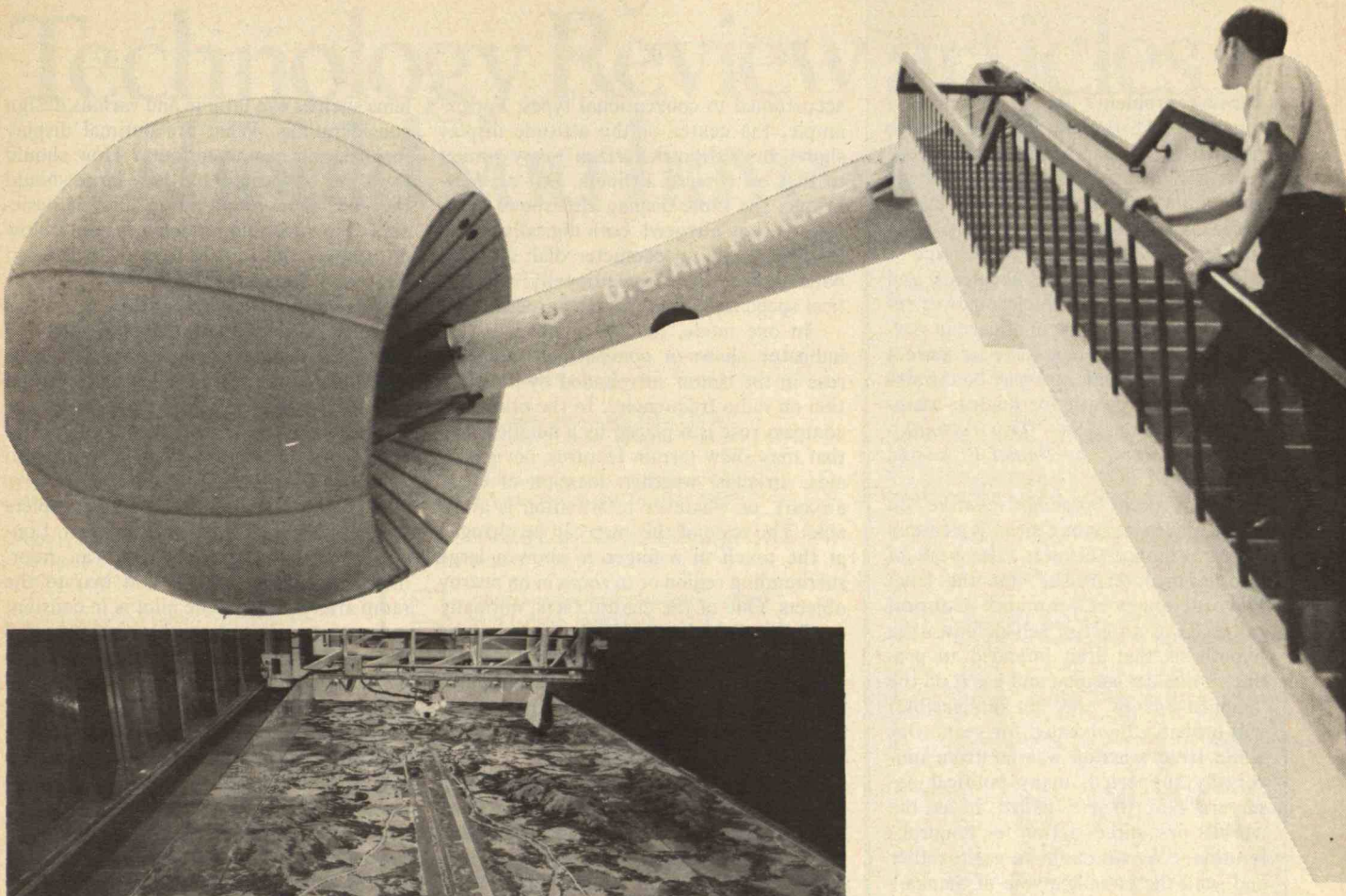
The pilot of the future will need far more information than now available, including the locations of neighboring aircraft and sensors for new devices such as the microwave landing system. This is frustrating for the designer, for there simply is no place to put these new displays and controls: the inside of the cockpit—including the walls and ceiling—is already completely covered. The system is costly and unreliable to the engineer—hydraulic controls were a principal cause of the DC-10 crash at Chicago.

A Simulator in Surrey

How all these frustrations will be resolved is reasonably clear. The controls will be separated from the displays, which will be solid-state, electronic, multipurpose devices—that is, a particular device will show one kind of information at one time and a different kind at another. Thus, the cockpit will have a few cathode-ray-tube display screens, a panel of buttons and switches for selecting specific displays, and a set of control switches and buttons not too dissimilar from the present ones except that they will be separated from the displays. Behind these panels will be only wires, because everything will be electrical rather than electromechanical, mechanical, or hydraulic, with high reliability.

The next generation of aircraft—the Boeing 757 and 767, the Douglas plane still referred to as the DC-X, and the European Airbus A300 series—will move in these directions. For example, the B-767 will have a CRT display for altitude and another for navigation, both of which will permit appropriate mode changes. But the following generation of aircraft built in the 1990s and operated in the twenty-first century will have the all-electronic cockpits.

Meanwhile, the only such cockpit in the world is in a simulator at the British Aerospace Corp., the primary British manufacturer of aircraft in Weybridge, Surrey. This simulator does not move, and there is no external vision system. Other simulators, especially those used for pilot training, have both these realistic aspects to an extraordinary degree. For example, a simulator at NASA's Ames Research Center in



Moffett Field, Calif., has six degrees of freedom (up-down, back-front, left-right, and pitch, yaw, and roll), lateral motion of over 100 feet to reproduce motion sensations realistically, and on the windscreen a three-dimensional color representation of the terrain in remarkable detail. All this is under computer control so that when the pilot steers, the cockpit turns, as does the presentation on the windscreen. Such realism is desirable but not essential in the Weybridge simulator, which is not used for training, and would have increased the cost enormously above the £1.5 million already expended.

Computerized "Knee Pad"

The basic cockpit is that of an Airbus A300, a British Aerospace airplane comparable to the new Boeing 767, operated by a crew of two. The size and shape of the cockpit and the positions of the seats and controls are identical to those of the actual aircraft, but there the resemblance ends. Below the windscreen in front of the pilots is a clean, bare panel with seven CRTs and a few warning lights. To the left of the left seat are large sets of buttons for controlling these displays, and in the ceiling are all the rest of the buttons and switches. Thus, all data are in front, all aircraft controls are above, and computer controls are on the side. And even though the switches are above, the pilot can find the information—which switches are on, which valves are open, which devices are under manual control—also displayed on the CRTs.

Not only are the data divorced from the controls, but the flight information displays are completely separate from the engine and system displays. The flight information displays consist primarily of electronic attitude and horizontal position indicators. The two CRTs on the left display these to the pilot, and the two on the right show the identical information to the copilot. Either CRT can be used for either display, they simulate existing displays simply to make them more acceptable to pilots

Flight simulators for studying tomorrow's aircraft today:

This page, top: the U.S. Air Force large-amplitude multimode simulator at Wright-Patterson Air Force Base for studies of new aircraft and flight control systems.

Above left: terrain represented in greatest detail for NASA's simulator at the Ames Research Center, Moffett Field, Calif.

Opposite page: The British Aerospace advanced flight-deck simulator in Weybridge, England. Television-like CRT displays substitute for dial-faced instruments: the two outer screens show speed, altitude, and attitude; inboard of these are map and compass displays; and the three center screens show engine, electric, and hydraulic conditions.

Marcus/Continued from page 7

ber-one problem? At first glance, a nuclear bomb (or, more likely, a large number of nuclear bombs) poses problems that dwarf those of a meltdown. But while nuclear war, most analysts agree, is an all-or-nothing event, reactor-derived "distortions" embrace a wide range of possible accidents and intentional misuses. Nuclear power reactors, under the control of certain governments, may in fact serve as sources of nuclear weapons, and may be the single most likely path for nuclear-weapons proliferation. (*See "Two Technologies, One Atom," by Daniel V. Edson, p. 20*).

Israel's recent "preemptive strike" on Iraq's nuclear reactor *Osirak* is a case in point. Whether this was "the peak of international terrorism" (as the Iraqi Revolutionary Command Council called it) or an act of self-defense (the hypothesis that Iraq intended to produce a nuclear weapon and use it on the "Zionist enemy" was not implausible) will probably be debated for years. But while Israel's action was far from universally supported, many political observers nevertheless hailed it as the world's first direct action for nonproliferation. "We all ought to get together and send the Israelis a vote of thanks," said the *Wall Street Journal*.

The real-world case of the nuclear-weapon/nuclear-reactor combination is clearly more subtle than that of the Tsipis and Fetter model: it isn't the weapon being used against the reactor that's so worrisome, but the reactor, in the wrong hands, producing the weapon. The "power plant," in effect, might well be the attack*er* instead of the attack*ee*.

That the Israelis consider Iraqi hands to be the wrong ones is obvious—Prime Minister Menachem Begin called President Saddam Hussein a *meshuguhnuh* (a crazy man), among other things. Yet ironically, Israel itself has The Bomb, or at least the capability to deploy it in a hurry. And who can say whether one country's reasonable ally is another's *meshuguhnuh*? The situation symbolizes the failure of the industrialized nations to stem nuclear proliferation—both "vertical" (among the haves) and "horizontal" (among the have-nots)—at its political and technological sources. □

Steven J. Marcus is managing editor of Technology Review.

accustomed to conventional types. For example, the center of the attitude display shows an "artificial horizon" very similar to that on current airliners. But at Weybridge, the same display also shows other information: airspeed, both digitally and in a conventional speedometer dial; altitude, both digitally and conventionally; and vertical speed and some reference speeds.

In one mode, the horizontal situation indicator shows a conventional compass rose in the center surrounded by information on radio frequencies. In the other, the compass rose is replaced by a detailed map that may show terrain features, navigation aids, airfields, weather, location of other aircraft, or whatever information is available. The scale of this map can be changed at the touch of a finger to show a large surrounding region or to zoom in on nearby objects. One of the central CRTs, normally used for the engine display, shows the major operating data in digital and conventional form for each engine, and in appropriate cases shows both the commanded and achieved values by means of a "bug" that moves along the scale.

The use of CRTs allows for fascinating possibilities. For example, the crew must follow innumerable checklists—the landing checklist includes "wheels down and locked," "flaps down," and so forth. Normally these lists are written on a pad held in the hand or on the knee of the copilot or flight engineer, and read aloud as the pilot confirms that each item has been performed. At Weybridge the checklist appears on a CRT, with an electronic cursor. As the pilot verifies that the appropriate act has been performed, he or she presses a button that erases that item and moves the cursor down to the next one. It is also possible to skip an item without erasing it and go on with the rest of the list, although it's not possible to go on to the next "page" until all items have been checked off.

In case of emergency, such checklists can be invaluable. For example, the "engine on fire" checklist can easily be called up. (Although not possible in the present simulator, it could be called up automatically when an instrument indicated such an emergency.) Appropriate pages from an entire trouble-shooting book can be presented as desired by the pilot, copilot, or computer.

To Design Better Aircraft

The general concept of the CRT-instrumented cockpit has now been well evaluated. What remains to be studied are problems such as eye fatigue and various design considerations. What are optimal display formats and character fonts? How should the CRTs be located and how large should they be? How much redundancy is desirable? How reliable is such a system? How do people react to it in time of stress, and how can it be improved?

The tool for answering these questions is full-mission simulation. The crew is briefed on a flight, usually London to Paris or Paris to London (although the simulator could be used for flights anywhere), except for the faults that are going to occur and deviations from the original flight plan ordered by air-traffic control.

The pilot then goes through a complete simulation in real time. A flight from London to Paris will take about an hour, including taxi to takeoff and taxi to the ramp after landing. The pilot is in constant radio communication with the "tower," "air-traffic control," and various other people, and the instruments give readings on position, attitude, and speed according to the actions of the flight crew. Thus, if the steering is turned to the left, the attitude display will indicate the new attitude, the horizontal situation indicator will show the new heading, and the navigation data will subsequently show that the aircraft traveled on this new heading.

Something unexpected happens in most simulated flights, preprogrammed but unbeknownst to the flight crew. This may be an engine fire, fuel-pump failure, or sticking valve. These problems may involve engineering questions—such as how to design lights and sounds for warning purposes—or human-factors questions, such as the ability of the crew to process information under stress.

A facility with such multifaceted capabilities is an extremely powerful tool for improving aircraft design. The United States now sells commercial aircraft to the rest of the world chiefly because it has the technological design tools, such as wind tunnels, to build better aircraft. In the future, a simulator such as this one will be essential for any nation that wishes to compete in aircraft production. □

Robert E. Machol is professor of systems in the Kellogg Graduate School of Management at Northwestern University. He did scientific liaison work while on leave last year at the London Branch Office of the U.S. Office of Naval Research, from whose European Scientific Notes *this article is adapted.*

How many of these Technology Review articles should you have read?

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A Look Beyond

Cosmos
Carl Sagan
Random House, 1980, $19.96

Reviewed by Michael Riordan

KAREN WATSON

ASTRONOMY and astrophysics have been in a state of rapid ferment since the middle of the 1960s. The discovery in 1965 of the uniform microwave background radiation from deep space provided convincing evidence that our universe began in a colossal fireball somewhere between 15 and 20 billion years ago. The "Big Bang" model of an expanding universe soon won almost total acceptance in the astrophysical community as steady-state theories quickly faded from sight. Over the past 15 years, this model has provided an increasingly coherent framework—a way to organize space, time, energy, and matter—for the history and evolution of our cosmos. Many puzzles remain to be solved, but the broad outlines of a comprehensive cosmology now seem fairly well established.

A hallmark of the Big Bang cosmology is evolution. An expanding universe is an evolutionary universe: structures and form, complexity and diversity, are developing spontaneously from very simple beginnings. There have been a number of believers in a chaotic early universe, but they have been repeatedly confounded by the scientific evidence. In its first few minutes, the universe was instead a dense, uniform, highly symmetrical plasma of subatomic particles at tremendous temperatures. Only as it expanded and cooled did the myriad features we now recognize as galaxies, stars, planets, and moons begin to crystallize out of this plasma. Eons later, evolution of complex forms occurred in very different realms—geological, biological, and social, to name a few.

Having resolved the objects of our experience into a few seemingly structureless particles interacting via a few simple forces, physical scientists now confront the opposite question: how did the diverse phenomena that we now perceive ever evolve from such simple beginnings? In its many ramifications, this is perhaps the central question facing cosmologists today.

A number of recent books have attempted to describe the features of this Big Bang cosmology, but none quite so ambitious as *Cosmos* by Carl Sagan. A companion to the $8 million PBS television series, this volume occupied one of the top slots on the best-seller charts for months. Lavishly illustrated with colorful paintings and photographs from the series, the book tries to bring the main features of modern cosmology to an audience of general readers. For Sagan, it's a very personal journey revolving about a theme that has occupied his attention for most of his professional career: the nature and existence of intelligent life. This theme first surfaced in *Intelligent Life in the Universe*, which he wrote with the Russian scientist I.S. Shklovskii in 1966. It has formed the backbone of his popular books ever since, such as *The Cosmic Connection* (1973), *The Dragons of Eden* (1977), and *Broca's Brain* (1979). If anyone brings scientific legitimacy to the study of extraterrestrial intelligence, it is certainly Carl Sagan.

A Pleasant Surprise

I must confess that I opened this book expecting disappointment. Despite a few brilliant sequences, the television series had been a tedious affair. Mired in Sagan's pedantic dialogues and self-absorption, the show delivered far less information in 13 hours than it might have. Then, too, most books based on PBS series have been tepid rewrites, a way to repackage all the expensive graphics and film footage for one more pass at the consuming public.

But *Cosmos* the book is altogether different. The chapters follow the same basic themes but deliver a lucid, unpretentious narrative that far surpasses the series in its attention to detail. Sagan does an admirable job of assembling the pieces of the great cosmic puzzle into an informative yet entertaining whole while managing to keep *himself* out of the picture and concentrate on the scientific data and their possible interpretations.

Specialists in astronomy, astrophyics, and cosmology will probably be disappointed, but scientists in other fields will find it a worthwhile and highly readable summary of current cosmological thinking. Without a doubt, Carl Sagan is a gifted science writer. He has a knack for explaining scientific theories, arguments, and evidence without jargon. His colleagues may scoff, but this is a rare talent in a scientist. If more scientists could explain their work to the general public, pure science would have a much easier time attracting public funds in the 1980s.

A Conceptual Leap

Cosmos is not merely a tale of modern cosmology but the story of humanity's evolving perspective. Sagan tells of Eratosthenes' measurements, in the third century B.C., of the circumference of the earth, the first real scientific evidence that the earth was round. He details the evolution from the earth-centered model of Ptolemy complete with crystal spheres and epicycles, to the sun-centered model of Nicholas Copernicus with its circular orbits, to the precise measurements of the planetary motions by the alchemist Tycho Brahe, and finally to their eventual interpretation by Johannes Kepler and Isaac Newton.

I only wish Sagan had spent more time with Newton and less with Kepler. For me, the conceptual leap from a few phenomenological rules of elliptical orbits to a universal law of gravitation is by far the greater achievement, one that lies at the heart of modern science. But on the whole, Sagan does an admirable job of relating how humanity's cosmic perspective has evolved to where we now see the earth as an insignificant planet of a humdrum star lost between two spiral arms in the outskirts of a galaxy, tucked away in some forgotten corner of a universe in which there are far more galaxies than people.

On planetary physics and evolution, Sagan is on his home territory, and it shows. As director of the Laboratory for Planetary Studies at Cornell, he was a leading participant in the Mariner, Voyager, and Viking expeditions to the nearby planets. We get

an insider's opinion of why no convincing evidence of life on Mars was obtained, but how a definitive experiment that could have provided a more conclusive answer was dropped for lack of funding. We are privy to the excitement at mission control as the first close-up photos of Jupiter's moons reveal an astonishing diversity of new worlds. We are given insight into the *process* involved in gathering the data upon which conclusions about the cosmos are made.

Jumping the Gun

Unfortunately, *Cosmos* begins to wander when Sagan ventures beyond the solar system and his own realm of expertise. Here, hard scientific fact gives way to speculation. Behind every concentration of mass in the cosmos Sagan discerns a black hole—a hypothetical entity for which some prominent astrophysicists doubt any evidence will ever be found. Sagan goes on to describe a few elaborate schemes for relativistic interstellar space travel as if they were ready to leap off the drafting table. Meanwhile, back in real life, NASA's funding is steadily evaporating.

This penchant for speculation is one of the book's most serious flaws; one gets the distinct impression that Sagan has simply given wing to his fantasy. His championing of the closed universe and its parallels in Hindu mysticism are indicative. Although the question is unresolved, most of the scientific evidence is strongly on the side of an open universe that will expand forever.

Another problem is Sagan's tendency to present his personal views as if they were established fact. In one striking example, Sagan recounts experiments by Stanley Miller and Harold Urey of the early 1950s on the origins of life on earth. Amino acids and other organic molecules were produced by electrostatic discharges in a reducing atmosphere of hydrogen, methane, ammonia, and water. Sagan presents these as truly representative of conditions on earth about 4 billion years ago, a notion for which there is little evidence.

Nonetheless, Sagan has succeeded in achieving his stated aims: the noble goal of bringing an intelligent treatment of cosmology to a wide audience. □

Michael Riordan, who received his Ph.D. in physics from M.I.T. in 1973, is editor and publisher of Cheshire Books in Palo Alto, Calif., coauthor of The Solar Home Book, *and presently at work on a book about cosmic evolution.*

Two Technologies, One Atom

Energy/War: Breaking the Nuclear Link
Amory B. & L. Hunter Lovins
San Francisco: Friends of the Earth, 1980

Reviewed by Daniel V. Edson

Atoms for Peace was arguably one of the stupidest ideas of our time . . . Civilian nuclear reactors are essentially bomb factories that produce electricity as a by-product. . . . Peaceful nuclear power provides the ingredients, the disguises, and much of the motivation that have brought India, Pakistan, Iraq, Israel, South Africa, Argentina, Brazil, and Taiwan the ability, now or soon, to explode a nuclear bomb . . . Nuclear power is both the main driving force behind proliferation and the least effective way to replace oil . . . Terrorist acquisition of bomb materials is becoming both possible and probable . . . We shall all blow each other up; the only question is when.

The opinions proffered by Amory and Hunter Lovins in *Energy/War: Breaking the Nuclear Link* might, at first glance, appear reactionary, sensational, overstated, or even unfounded. The suggestion that the world is cascading toward a nuclear end is not novel, but the promotion of an inextricable tie between nuclear power and nuclear war is.

The Lovinses contend that because of the intimate relationship between peaceful nuclear power and warlike nuclear armaments, nuclear power must be phased out before the threat of nuclear war can be eliminated. Without a doubt, this belief will attract fierce counterargument, but with more than 50 thousand nuclear bombs—1 million Hiroshimas—in the world today, with the incidence of nuclear accidents growing, and with proliferation continuing at a frightening pace, it seems prudent to examine the evidence.

The Link

Nuclear-fission technologies both use and produce fissionable materials that are or can be concentrated to be potentially explosive. Both the uranium fuel and the plutonium by-product of nuclear power can be treated, through enrichment and reprocessing, respectively, to create concentrated material suitable for bombs. Though weapons-grade plutonium is preferred for nuclear weapons, reactor grade will suffice in a properly designed bomb. Thus, the nuclear-power cycle can justifiably be accused of increasing the amount of available bomb material.

Consider: a large power plant produces hundreds of kilograms of plutonium each year, and a large reprocessing plant could separate tons of the material annually, yet a bomb with the destructive power of Nagasaki requires but a few explosive kilograms. The complexities of enrichment and reprocessing are deterrents to producing bomb materials from nuclear fuels and by-products, but dedicated, aggressive governments have demonstrated that with time, money, and/or dedication, enrichment and reprocessing capabilities can be acquired. Safeguards designed to prevent nuclear-power fuels and by-products from falling into the hands of bomb makers have proved largely ineffective, partly because of the inherent difficulty of measuring plutonium, but also because international agencies have been frustrated in their attempts to monitor and protect uranium and plutonium inventories. Enrichment and reprocessing could be lucrative clandestine industries in a world embroiled in an arms race.

Relatively little knowledge is required to fashion nuclear weapons, a fact well illustrated by undergraduates who have designed workable nuclear bombs using public information. Some experts estimate that a knowledgeable thief with the right equipment could assemble a bomb—or a convincing semblance of one—in minutes.

Nuclear-power fuels and by-products diverted to production of nuclear armaments are only part of the energy/war link. The two technologies have common equipment and general organizational structures, and the very existence of a nuclear-power program enhances the prospects for a nuclear-weapons program. By subsidizing the spread of nuclear power, training foreign nationals, and supplying equipment and service in addition to fuel, the United States and other countries with nuclear capability simply accelerate proliferation.

According to the Lovinses' detailed discourse on economics, electricity, and future energy needs, the nuclear industry is being supported by little more than subsidies, hope, and decaying predictions of high growth in demand for electricity. Rising costs; dramatically decreased demand forecasts; troublesome utility financing; the underestimated effects of alternative energy, conservation, and coal usage; and plummeting political acceptance have hastened the industry's slide. The Lovinses'

It Can Happen Here.

It was a quiet April evening, shortly before midnight, and Deanna Ussery had already gone to bed. The house was dark except for a nightlight in the bedroom of her eight-year-old daughter, Sheila Ann.

Suddenly, there was an explosion of gunfire, and 12-gauge shotgun slugs shattered Sheila Ann's bedroom windows, ripping her bedspread and tearing holes in the wall just above her bed. Miraculously, no one was hurt. Sheila Ann was away for the night.

A made for TV movie? No, a real-life story of terror in Hot Springs, Arkansas, as set forth in the official record of a trial against a United Steelworkers of America local in Garland County Circuit Court.

It is a story of union violence and harassment against five courageous women who defied the strike orders handed down by officials of a USW local against National Rejectors, Inc. of Hot Springs.

Even after the strike was over, the women were subjected to name calling, obscene language and threats. Glue or grease was rubbed on their chair seats at work. Supervisors had to accompany them to the bathroom for their protection.

There were repeated incidents of hair-pulling, shoving, slapping and tire-slashing. They were pursued in their cars by thugs who tried to run them off the road.

The terror might have continued for many more months if it hadn't been for the National Right to Work Legal Defense Foundation. The Foundation is the only publicly supported charitable institution in America organized solely to provide free legal aid to employees whose rights have been violated because of abuses resulting from compulsory unionism.

After being asked for help, Foundation attorneys immediately filed charges with the National Labor Relations Board, demanding an end to the campaign of intimidation and terror. The Board swiftly responded and the union publicly promised not to engage in such activities in the future if the NLRB agreed not to prosecute.

With the Foundation's assistance, the five women also brought suit against the union and its officers in the Arkansas state court. In May 1980, a trial court jury awarded them a total of $250,000 in damages to compensate them for their losses and suffering, and to punish the union for its lawlessness.

The National Right to Work Legal Defense Foundation is currently helping American workers in more than 100 cases across the country, ranging from other union violence cases to those involving academic and political freedom and other fundamental rights. But it would like to do even more.

If you'd like to help Deanna Ussery and other workers like her, we'd like to hear from you.

The National Right to Work Legal Defense Foundation
8001 Braddock Road
Springfield, Virginia 22160

Books/Continued from page 20

message is clear: with economic feasibility fading and need evaporating, when do we let the market take its toll and phase out nuclear power? Included in this collapse is the failure of advanced plutonium technologies, such as the fast breeder reactor, fraught with economic and technical problems of their own.

Lack of demand for electricity has been a major problem of the nuclear industry. The Lovinses point out that the current overcapacity *above* an acceptable 15 percent reserve margin is equal to two times the present nuclear output. At a time when some experts are recommending that nuclear plants under construction be abandoned, Three Mile Island is burdened with a $1.3 billion cleanup bill, and investors are as scarce as kilowatts at Seabrook, N.H., one wonders where nuclear power would be if it had not had years of preferential treatment.

Nonnuclear Future

To end world involvement in nuclear power and in turn reduce the threat of nuclear war, the Lovinses propose three actions: that we accept the free-market verdict and drop nuclear energy, that we initiate international arms reduction, and that we emphasize soft-energy technologies. Although many who scoff at the concept of a soft-energy structure are very convincing in their contention that alternative energy and conservation cannot meet world energy needs, proponents of soft energy can present equally convincing arguments. A 1979 Harvard Business School study showed that the least expensive energy improvements, in order, are improved efficiency, soft energy, synfuels, and last, power plants.

Conversion to soft technologies is occurring much more rapidly than predicted. There is a de facto moratorium on reactor orders in the United States and ten other countries, nuclear energy has been abandoned in at least seven countries, and one country, Sweden, recently voted to phase out nuclear power permanently within 25 years. General Electric, a major U.S. supplier, admitted in its 1980 annual report that its nuclear business, booming less than a decade ago, is expected to have "continued losses," adding that "cancellations have substantially outnumbered orders in the last six years."

Although the ideas, principles, and lifestyle changes the Lovinses dictate are not easy to digest, picking apart their detailed and comprehensive arguments is a lesson in futility. Unfortunately, *Energy/War* is probably too difficult to read for those who most need to understand the nuclear-power/nuclear-weapons interdependence—world leaders, politicians, energy executives, and military commanders. Those with a working knowledge of physics, fission, and isotopes, as well as economics and foreign affairs, will feel comfortable with the material, but most prospective readers will stumble through the prologue and quit. The subject is monumental; the book is staggering. □

Daniel V. Edson, associate editor of Design News, *has a degree in mechanical engineering and a particular interest in nuclear power and related technologies.*

Letters/Continued from page 4

cluded in his report that "the controls are inappropriate—if any good at all—to the study for which they were selected."

In separate reports, Dr. Howard Sanders of the Woods Hole Oceanographic Institution and Drs. J.H. Baker and C.A. Bedinger of the Southwest Research Institute in Houston described these regions, including both the rig and control sites, as very highly stressed marine environments. I do not ask that GURC be held to criteria of "negative proof"; I merely ask that they be rigorous and honest in reporting their results.

Dogmatism

Any person whose views are strongly held and that conflict with 99 percent of the population is dogmatic. Kenneth Boulding is such a person. I know very few people who feel that "national defense is a cancer" or that "defense can only assure our destruction." I can also show a large body of economic data that refute the proposition that military spending is linked to declining productivity. Is it more productive to pay people to do nothing?

Thomas F. Hafer
Arlington, Va.

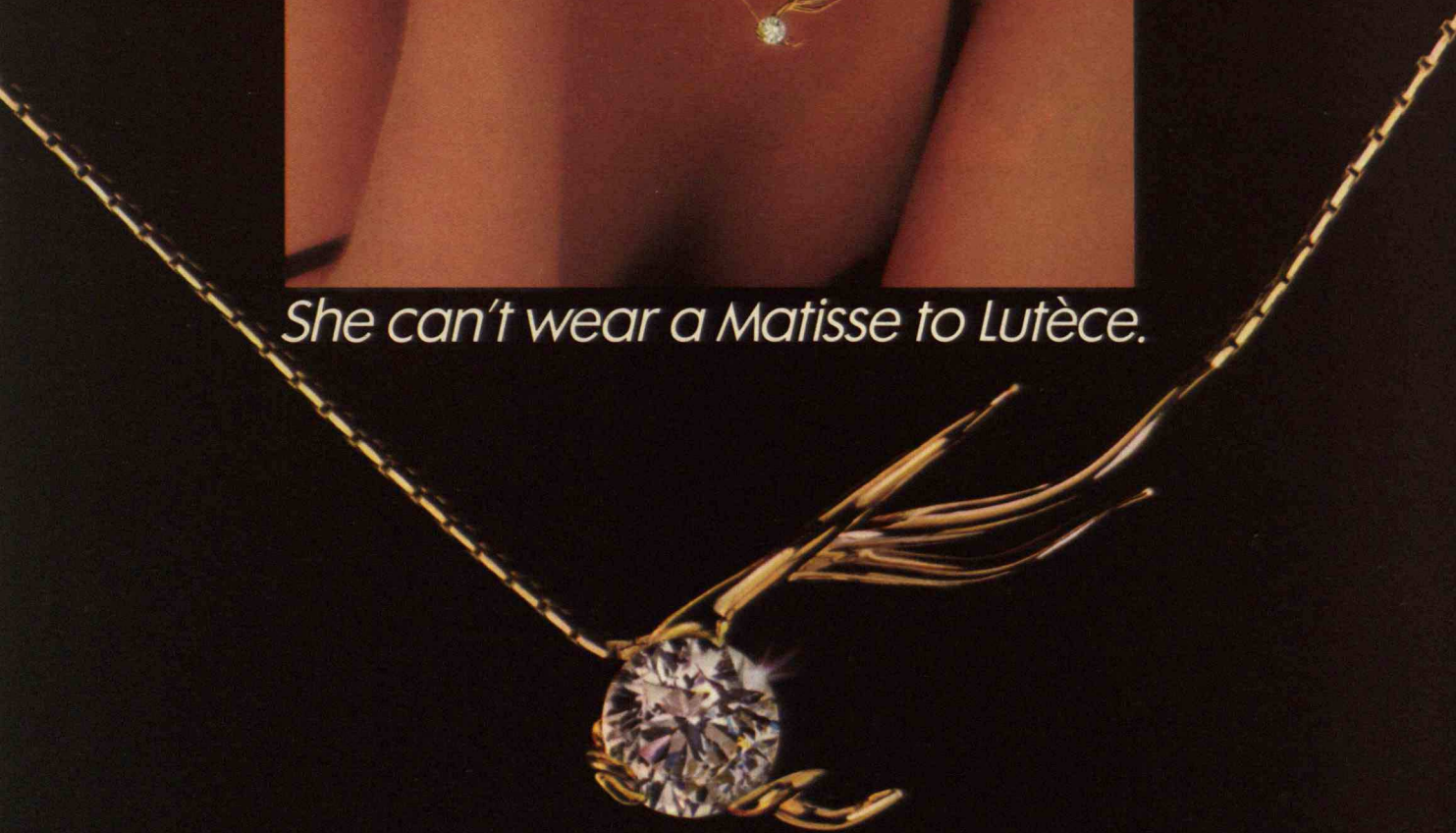
One More Time for the Auto

The "typical hybrid configuration" referred to by Professors Heywood and Wikes in "Is There a Better Automobile Engine?" (*November/December, p. 18*), known as the "series" hybrid, has been discarded since 1975. All serious programs employ the *parallel* hybrid, in which the heat engine can provide some power directly to the propulsion system. The key is to transfer some of the drive energy from onboard liquid fuel to off-board electricity by charging the batteries when the vehicle is not in use. Total energy may or may not be saved but petroleum is, by perhaps 50 percent.

Victor Wouk
New York, N.Y.

Dr. Wouk is technical advisor for the United States National Committee of the International Electrotechnical Commission—Ed.

She can't wear a Matisse to Lutèce.



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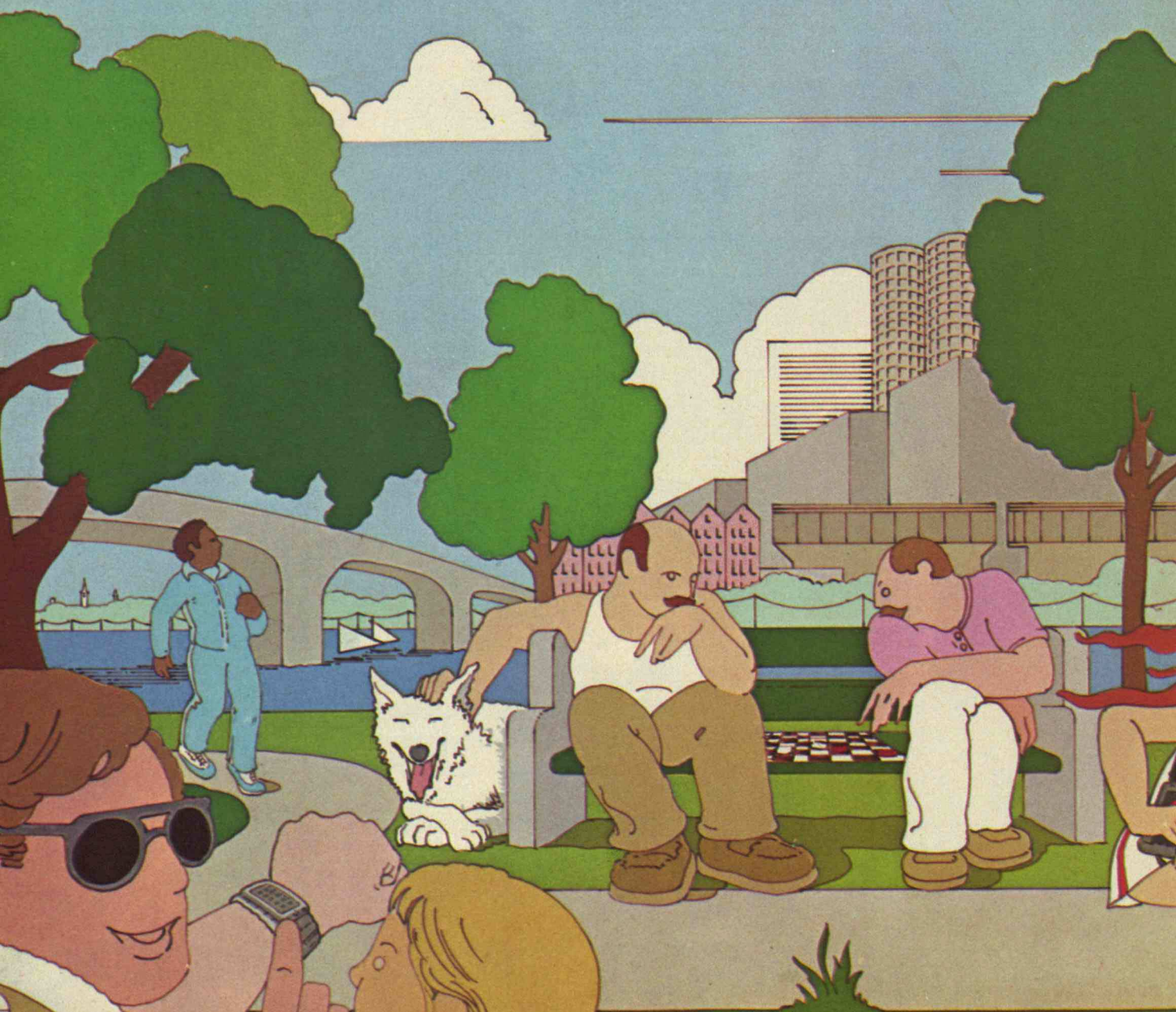
Living with Technology: Trade-Offs in Paradise

by Samuel C. Florman

Technology, lately blamed for many of the world's ills, is neither panacea nor curse but a collective expression of human desires, creativity, and perseverance.



In the fall of 1979 the Humanities Department of the University of Michigan's College of Engineering sponsored a symposium entitled "Technology and Pessimism." The announced purpose of the event was "to examine why and in what ways technological development has led to pessimistic assessments of the future." Just a few years ago such a statement would have made no sense. Today it sounds like the most appropriate theme that could possibly be selected for an academic conclave.

I was invited to participate in the opening session of the three-day program and found myself paired with Melvin Kranzberg, professor of the history of technology at Georgia Tech and long-time editor of the quarterly *Technology and Culture*. Kranzberg spoke at 4:00 o'clock in the afternoon, and I at 8:00. The following morning we were both scheduled to participate in a panel discussion.

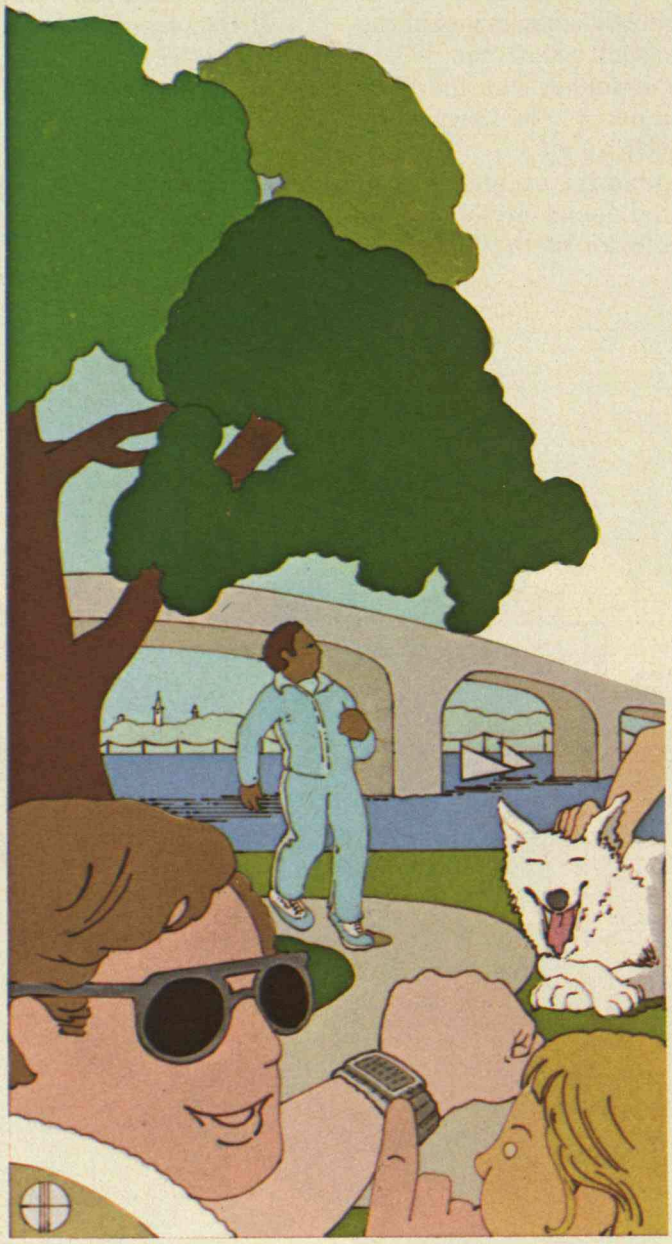
If the planners of the event had hoped to start off with speakers who themselves felt pessimistic about technology, they had chosen the wrong twosome. Kranzberg, joviality personified, quickly showed that he had no patience with prophets of technological doom. In ringing tones he reminded his audience that technology has progressively made life longer and more comfortable while at the same time fostering the

ILLUSTRATIONS: MICHAEL G. COBB

The concept of runaway technology has become much the vogue among academics.

concept and practice of social justice. Problems have arisen, he maintained, because of people's continually rising expectations, and because in some instances technology has been appropriated by narrow interest groups. What is required, he concluded, is social innovation—improved means of exerting democratic control over technological decisions.

When my turn came, I argued that neither childish optimism nor petulant pessimism was an adequate response to our technological problems, and I suggested that a mature recognition of realistic possibilities would be more appropriate. Kranzberg had entitled his lecture "Technology: The Half-Full Cup." In the same vein, I told the parable of the two children in the garden, one who complained about thorns on the rose bushes, the other who said happily, "Mommy, the thorn bushes have roses!" We were both so reasonable—"on the one hand and on the other hand"—and the reception accorded us was so friendly that it was difficult to imagine there being a single person in the audience who did not agree with us.



The mellow mood that prevailed reminded me of a symposium in which I had participated a couple of years earlier at Lafayette College entitled "Technology and the Human Condition." On that occasion Isaac Asimov had entertained one and all with his mockery of antitechnologists who would like to be back in old Athens "yakking it up with Socrates." The truth is, said Asimov, that most of the people in ancient Greece worked like animals and died young. We should be thankful for technology; even though it gets bad press, it can be used wisely or unwisely. All of the other speakers agreed, the audience applauded, and everybody went home in high spirits.

This is just like it was at Lafayette, I thought as I got ready for bed that evening in Michigan—everything so cordial and civilized. Thank goodness it isn't like Albion College, where I had to debate lifestyles with a hippie from a commune and an abbott from a monastery, or like Smith College, where an angry feminist reviled technology and its defenders for being "macho." I enjoyed the deep sleep of the complacent.

What's Fit to Print

The next morning's panel discussion was moderated by John Broomfield, a University of Michigan history professor. Since I had enjoyed his affable company at a faculty dinner the previous evening, I was startled when he opened the proceedings on a hostile note. "No shred of optimism," he said, "is added to my view of our current technology and its spokespeople by the arguments of our first two speakers." He then launched into a bitter tirade against high technology and its sponsors. I had heard its like before, but I found this version particularly unsettling because it was unexpected. Technocrats, according to Broomfield, are developing large-scale technological systems that disenfranchise the average citizen, erode civil liberties, and produce "specialized ignorance for some and generalized ignorance for most." This new order is peril-

But what is it that is really running away? Is it technology or is it fear of technology?

ously vulnerable to disaster because, being exceedingly complex and neither "natural" nor "biological," it has become "intolerant of mistakes." Not only is high technology the malignant product of a bureaucratic technocracy, Broomfield continued, but it also appears to have gotten out of control: "If you have a new technique you encourage its widespread adoption; if you have a new product you peddle it everywhere."

The professor's attack encouraged others in the audience who had been silent the previous day. Soon we were hearing a young man compare farm tractors unfavorably with oxen; a woman rose solemnly to announce that the very building in which we were meeting should never have been constructed since it was situated on terrain that once was sacred to a local Indian tribe. By the end of the morning session, my mood had soured considerably.

A few days later, an article about the conference appeared on the front page of the *New York Times* science section. At first I was pleased to see it; there is a primal satisfaction connected with finding one's name in the newspaper. But then I wondered, considering all the important developments in science and technology, why the dispirited musings of an academic symposium should receive so much attention.

"Scholars Confront the Decline of Technology's Image," read the headline. This reminded me of how often I had seen similar headlines prominently displayed in this same newspaper: "*Skylab* and Other Mishaps Tarnish Technology's Image," "Scientific Decisions: The Baffled Public," "Scientists and Society's Fears," and so forth. In a series of philosophical essays, this august voice of the American establishment had been brooding about the public's fear of technology. As I read the article about the Michigan symposium, I felt increasingly uneasy. Academic handwringing is one thing, but the press treating it as important news is something else entirely.

To be sure, there had recently been no shortage of anxiety-producing technological incidents: oil spills, airplane crashes, collapses of dams and auditorium roofs, the descent of *Skylab*, the discovery of toxic materials at Love Canal, and the uniquely alarming accident at the Three Mile Island nuclear plant. Yet this litany does not explain the change in journalistic perception of technology, for never in the history of newspapers has there been a shortage of technology-related catastrophes. They have long been the very stuff of headlines and extra editions: train wrecks, falling bridges, bursting boilers, collapsing buildings, devastating fires, explosions in mines and factories, lead poisoning, botulism. . . . Incidents occur no more frequently today than they used to, and the consequences are no more ghastly. There were also plenty of long-range, enduring torments associated with technology—city slums wretched beyond telling, disease-causing tanneries, foul-smelling gasworks, grime-filled air—a long, sordid list we have been happy to forget.

Nor was there ever a shortage of spirited reporters and editors to report on these intolerable conditions. It was always the pride of journalists to complain about carelessness, ignorance, laziness, and greed, and to insist that in the future there be improved performance. Even the revelations that led to identification of an "environmental crisis" were greeted at first with outrage and sermonizing. When newspapers start becoming melancholy—or even dwelling upon the melancholy of others—one cannot help thinking that something is terribly wrong. At least that is the way I felt as I read in the *Times* of "growing doubts about society's ability to rein in the seemingly runaway forces of technology."

A New Blue Mood

What is it, however, that is really running away? Is it technology, or is it fear of technology? The newspapers print scare stories; people read the stories and become alarmed; and then the newspapers quote the people expressing their alarm. Television, with reports that stress helplessness in the face of calamity, increases the tension. An academic symposium is scheduled to consider what is happening, and it in turn becomes news. The hysteria feeds on itself.

Perhaps this is not being fair to the media—the current mood of apprehension was not created out of thin air by editors and reporters. It has percolated through our social consciousness in a diffuse pattern that is almost impossible to trace. It starts with disasters, but as I have said, there have always been disasters. It is the way we respond to disasters that has changed. If occasional indignation has given way to lingering skepticism, that is understandable enough: utopia was promised and it isn't coming. But if a sense of helpless resignation is taking over—if technology, after changing from boon to disappointment, is now perceived to be changing from disappointment to *threat*—then somebody had better try to find out what is happening, and quickly.

Clearly, the change in mood has been inspired in part by a number of lionized science writers such as

While researching the history of American know-how, I became impressed by our forebears' pattern of progress, setback, and renewed creative effort.

Rachel Carson and Barry Commoner. These persuasive alarmists have cautioned that the problems we face today are far more grave than those we faced in the past. Whether or not this is true, these critics have given useful warning and gone on to suggest alternative courses of action. It cannot be said that they tried to cultivate fear of technology itself, yet their eloquent polemics may have oversensitized the public in ways that were not intended. The same paradox pertains to advocates of the "counterculture" who, in voicing opposition to certain manifestations of technology, have helped to spread the belief that "the machine" will inevitably take over. Warnings intended to bring about constructive action seem inadvertently to spread fear and paralysis.

Another source of the new anxiety lies deep in the tomes of introspective scholars such as Jacques Ellul and Lewis Mumford. Not many people buy, much less read, the works of these savants, yet their dolefully deterministic view of technology is revealed to the public in book reviews, and disseminated throughout intellectual circles by articles and abstruse journals. Starting in the early 1970s, the concept of runaway technology became much the vogue among academics. Articles, books, and dissertations devoted to this theme began to appear in great number, abetted no little by funding of "technology and society" studies by both the National Science Foundation and the National Endowment for the Humanities. By 1977 this school of literature was growing at such a rate that Langdon Winner, an M.I.T. professor, was moved to review the issue in a book entitled *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought.*

Book titles tell a lot about what is happening to a culture, and during the 1970s there was ample evidence that the American love affair with technology was in trouble. Bookstore windows displayed serious works with titles such as *The Illusion of Technique* and *The Poverty of Power*, along with stacks of mass-market paperbacks such as *Future Shock* and *Overskill.*

Such subliminal influences have been reinforced by the comments of respected sages as reported in important places. Robert Penn Warren, interviewed in *U.S. News & World Report*, predicts that "in the technetronic age . . . the boys who handle the post-computer mechanisms . . . will inevitably be in control . . . with a vast, functionless, pampered, and ultimately powerless population of nonexperts living on free time, unemployed and unemployable."

Daniel J. Boorstin, librarian of Congress and Pulitzer Prize-winning historian, writes an essay for *Time* magazine striking a somber note: "The Republic of Technology where we will be living is a feedback world. There wants will be created not by 'human nature' or by century-old yearnings but by technology itself." John Hersey speaks at a convocation at M.I.T., and his remarks about "the growing public hostility to technology" are reported in the syndicated column of Anthony Lewis.

Antitechnology, which for a while seemed to be a rather harmless—possibly even wholesome—undercurrent of intellectual rebellion, is suddenly a rushing tide. In their comfortable parlors, readers of the *New Yorker* are subjected to weekly elegies: "The Faustian proposal that the experts make to us is to let them lay their fallible hands on eternity." In thousands of barbershops, the readers of *Penthouse* are given less subtle warnings: "In the darker sense, technology is *whatever you're not supposed to understand.*"

A measure of the pervasiveness of the new mood is the consternation of once-haughty scientists and engineers. In the spring of 1980, Philip Handler, president of the National Academy of Sciences, writing in the prestigious journal *Science*, expressed his concern in uncharacteristically urgent tones: "The intellectual elite in every era has always been pessimistic. But today, concerned that 'that which can be done will be done,' there has arisen an antiscientific, antirationalistic trend that should give us pause. . . . That anti-science attitude perniciously infiltrates the news media, affecting intelligentsia and decision makers alike. It must be confronted at every opportunity."

Apparently the seriousness with which the *New York Times* regarded the symposium on "Technology and Pessimism" was both effect and cause, a symptom of the nation's growing concern as well as a source of new anxiety. However, many intelligent and responsible people seem not to be unduly alarmed about technological change. And public-opinion polls show that the average citizen still considers science and technology to be, on balance, forces for good. Maybe I am overreacting.

In *The Existential Pleasures of Engineering*, I carefully considered, and tried to rebut, the antitechnological arguments of Jacques Ellul, Lewis Mumford, René Dubos, Charles Reich, and Theodore Roszak. A reviewer writing in *The Chronicle of Higher Education* said that for an engineer to complain about the works of such people "seems a little like an elephant complaining of being bullied by gnats." Well,

It is important to remember that our disappointments have not been limited to technology, a fact that the antitechnologists usually choose to ignore.

perhaps—but then it is common knowledge that gnats can torment large animals to distraction. A sting here, a buzz there, and all of a sudden we have the beginnings of a calamitous stampede. There is small comfort in thinking of the antitechnologists as gnats.

Fear of Trying

There are many different ways of trying to understand the antitechnological movement. A theologian might conclude that it is a long-overdue recognition of the ebb of rationalism, a development that could have been predicted four centuries ago when Copernicus and Galileo first challenged the teachings of the Church. A political scientist might view the changing mood as an expression of incipient revolution, since technology is perceived by some to be the means by which the ruling classes perpetuate their power over the masses. Through an anthropologist's prism, antitechnology can be seen as a new mythology, welling up in the effervescent depths of the cultural subconscious.

If one thinks in the language of psychology, a completely different hypothesis comes to mind, namely that the dread of technology is nothing other than a phobia, a condition that develops when people *displace* their anxieties (about death, separation, parental rage, or whatever) in an effort to control them. It is well known that certain objects or situations—such as crowds, heights, closed spaces, open spaces, and a variety of animals—can be endowed by individuals with special meaning and thereafter regularly induce anxiety. Omnipresent technology is an apt candidate for this list. Fear of flying is, in fact, being treated as a phobia, and much publicity has been given to the cures effected by techniques of behavior modification. The anxieties of people living in the vicinity of the Three Mile Island nuclear plant have also been the subject of much interest and some study.

The antitechnological movement can also be defined as a school of literary expression. According to Leo Marx, a leading light of M.I.T.'s Program in Science, Technology, and Society, the current pessimism about technology is a renewed manifestation of *pastoralism*, "an ancient mode of thought and expression embodying a negative response to social complexity and change." Pastoralism, says Marx, characteristically flourishes in times of accelerating social change; for example, Rome in the time of Virgil, England during the Elizabethan Age, and the United States since the start of the Industrial Revolution.

To the antitechnologists, of course, all these theories are ridiculous or, at best, beside the point. In their view, historical perspectives no longer apply, since changes have occurred that are unprecedented and fundamental. They see no sense in harking back to Virgil or the Industrial Revolution when we live in an age of computers, recombinant DNA, and nuclear power (to say nothing of nuclear weapons), with our resources dwindling and our environment degraded. If anyone is theologically confused, mythically muddled, or neurotically disturbed, they believe it is those who cannot see that technology really is out of control and that technocrats really are creating a hell on earth.

I am convinced that the antitechnologists are misguided, but the intensity of the antitechnological argument persuades me to pause. Too much of the discussion about technology, pro and con, has been on an intuitive level (where one can convince only oneself), or else cloaked in complicated theories that arise less from evidence than from the majestic intellects of their creators. Perhaps some simple facts will persuade an open-minded reader that the antitechnologists have been listening to the beating of their own hearts instead of looking at the world around them. It is easy to *feel* that technology is out of control and/or that technocrats are leading us astray, yet I believe that technology is still very much under society's control, that it is in fact an expression of our very human desires, fancies, and fears.

Progress, Setback, Progress

House & Garden magazine, in celebration of the American bicentennial, devoted its July 1976 issue to the topic of "American know-how." The editors invited me to contribute an article, and enticed by the opportunity to address a new audience, plus the offer of a handsome fee, I accepted. We agreed that the title of my piece would be "Technology and the Human Adventure," and I thereupon embarked on a strange adventure of my own.

I thought that it would be appropriate to begin my essay with a discussion of technology in the time of the founding fathers, so I went to the library and immersed myself in the works of Benjamin Franklin, surely the most famous technologist of America's early days. Remembering stories from my childhood about Ben Franklin the clever tinkerer, I expected to

We are constantly accusing each other of villainy when we should be consulting each other on how to best solve our common problems.

find a pleasant recounting of inventions and successful experiments, a cheering tale of technological triumphs. I found such a tale, to be sure, but along with it I found a record of calamities *caused by* the technological advances of his day.

In several letters and essays, Franklin expressed concern about fire, an ever-threatening scourge in colonial times. Efficient sawmills made it possible to build frame houses more versatile and economical than log cabins—but less fire-resistant. Advances in transport made it possible for people to crowd these frame houses together in cities. Cleverly conceived fireplaces, stoves, lamps, and warming pans made life more comfortable but contributed to the likelihood of catastrophic fires.

To deal with this problem, Franklin recommended architectural modifications to make houses more fireproof. He proposed the licensing and supervision of chimney sweeps and the establishment of volunteer fire companies, well supplied and trained. As is well known, he invented the lightning rod. In other words, he proposed technological ways of coping with the unpleasant consequences of technology; he applied Yankee ingenuity to solve problems arising from Yankee ingenuity.

In Franklin's writings I found other examples of technological advances that brought with them unanticipated problems. Lead poisoning was a peril. Contaminated rum was discovered coming from distilleries where lead parts had been substituted for wood in the distilling apparatus. Drinking water collected from lead-coated roofs was also making people seriously ill.

The advancing techniques of medical science were often a mixed blessing, as they are today. Early methods of vaccination for smallpox, for example, entailed the danger of the vaccinated person dying from the artificially induced disease. (In a particularly poignant article, Franklin was at pains to point out that his four-year-old son's death from smallpox was attributable to the boy's *not* having been vaccinated and did not result, as rumor had it, from vaccination itself.)

After a while, I put aside the writings of Franklin and turned my attention to American know-how in the nineteenth century, becoming engrossed in the early days of steamboat transport. This important step forward in American technology was far from being the unsullied triumph that it appears to be in our popular histories.

Manufacturers of the earliest high-pressure steam engines often used materials of inferior quality. They were slow to recognize the weakening of boiler shells caused by rivet holes, and the danger of using wrought-iron shells together with cast-iron heads that had a different coefficient of expansion. Safety valve openings were often not properly proportioned, and gauges had a tendency to malfunction. Even well-designed equipment quickly became defective through the effects of corrosion and sediment. On top of it all, competition for prestige led to racing between boats, and during a race the usual practice was to tie down the safety valve so that excessive steam pressure would not be relieved.

From 1825 to 1830, 42 recorded explosions killed upward of 270 persons. When in 1830 an explosion aboard the *Helen McGregor* near Memphis killed more than 50 passengers, public outrage forced the federal government to take action. Funds were granted to the Franklin Institute of Philadelphia to purchase apparatus to conduct experiments on steam boilers, the first technological research grant by the federal government.

The institute made a comprehensive report in 1838, but not until 14 years later was a workable bill passed by Congress providing at least minimal safeguards for the citizenry. We may wonder why the process took so long, but Congress was still uncertain about its right, under the interstate commerce provision of the Constitution, to control the activities of individual entrepreneurs.

When I turned from steamboats to railroads, I found another long-forgotten story of catastrophe. Not only were there problems with the trains themselves, but the roadbeds, and particularly the bridges, made even the shortest train journey a hazardous adventure. In the late 1860s more than 25 American bridges were collapsing each year, with appalling loss of life. In 1873 the American Society of Civil Engineers set up a special commission to address the problem, and eventually the safety of our bridges came to be taken for granted.

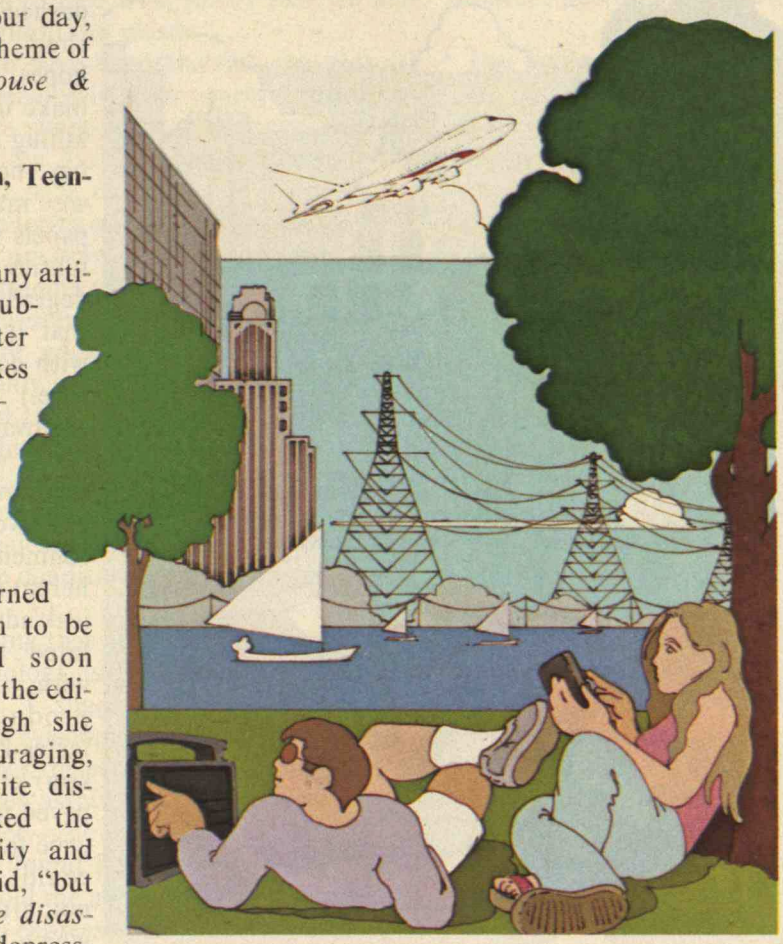
The more I researched the history of American know-how, the more I perceived that practically every technological advance had unexpected and unwanted side effects. Along with each triumph of mechanical genius came an inevitable portion of death and destruction. Instead of becoming discouraged, however, our forebears seemed to be resolute in confronting the adverse consequences of their own inventiveness. I was impressed by their pattern of progress, setback, and renewed creative effort. It seemed to have a spe-

There can never be a technologically based utopia because we cannot agree on what form that utopia might take.

cial message for our day, and I made it the theme of my essay for *House & Garden*.

Childish Optimism, Teenage Pessimism

No matter how many articles one has had published, and no matter how much one likes the article most recently submitted, waiting to hear from an editor is an anxious experience. In this case, as it turned out, I had reason to be apprehensive. I soon heard from one of the editors who, although she tried to be encouraging, was obviously quite distressed. "We liked the part about tenacity and ingenuity," she said, "but oh dear, *all those disasters*—they are so depressing."



I need not go into the details of what followed: the rewriting, the telephone conferences, the re-rewriting—the gradual elimination of accidents and casualty statistics, and a subtle change in emphasis. I retreated, with some honor intact, I like to believe, until the article was deemed suitably upbeat.

I should have known that the bicentennial issue of *House & Garden* was not the forum in which to consider the dark complexities of technological change. My piece was to appear side by side with such articles as "A House That Has Everything," "Live Longer, Look Younger," and "Everything's Coming Up Roses" (devoted to a review of Gloria Vanderbilt's latest designs).

In the United States today, magazines such as *House & Garden* speak for those, and to those, who are optimistic about technology. Through technology we get better dishwashers, permanent-press clothing, and rust-proof lawn furniture. "Better living through chemistry," the old DuPont commercial used to say. Not only is *House & Garden* optimistic, that is, hopeful, about technology; it is cheerfully optimistic. There is no room in its pages for failure, or even for struggle, and in this view it speaks for many Americans, perhaps a majority. This is the lesson I learned—or I should say, relearned—in the bicentennial year.

Much has been written about the shallow optimism of the United States, about life viewed as a Horatio Alger success story or a romantic movie with a happy ending. This optimism is less widespread than it used to be, particularly as it relates to technology. Talk of nuclear warfare and a poisoned environment tends to dampen one's enthusiasm. Yet optimistic materialism remains a powerful force in American life—we all know of people who, even at this troublesome moment in history, define happiness in terms of their ability to accumulate new gadgets. The business community, anxious to sell merchandise, spares no expense in promoting a gleeful consumerism.

Side by side with what I have come to think of as *House & Garden* optimism is a mood that we might call *New York Review of Books* pessimism. Our intellectual journals are full of gloomy tracts that depict a society debased by technology. According to this view, our health is being ruined, our landscape despoiled, and our social institutions laid waste. We are forced to do demeaning work and consume unwanted products. We are being dehumanized. This is happening because a technological demon has escaped from human control or, in a slightly different version, because evil technocrats are leading us astray.

It is clear that in recent years the resoluteness exhibited by Benjamin Franklin, and other Americans of similarly robust character, has been largely

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displaced by a foolish optimism on the one hand and an abject pessimism on the other. These two opposing outlooks are actually manifestations of the same defect in the American character: both reflect a flaw that I can best describe as immaturity.

Young children are optimistic, naively assuming that their needs can always be satisfied and that their parents have it within their power to "make things right." Children frustrated become petulant. With the onset of puberty a morose sense of disillusionment is apt to take hold; sulky pessimism is something we associate with teenagers.

It is not surprising that many inhabitants of the United States, a rich nation with seemingly boundless frontiers, should have evinced a childish optimism and declared their faith in technology, endowing it with the reassuring power of a parent and regarding it with the love of a child for a favorite toy. Technological setbacks would then be greeted by some with the naive assumption that all would turn out for the best and by others with peevish declarations of despair. Intellectuals have been in the forefront of this childish display, but every segment of society has been caught up in it. Technologists themselves have not been immune: in the speeches of nineteenth-century engineers, we find bombastic promises that make us blush. Today the profession is torn between a blustering optimism and a confused guilt.

Comedy Tomorrow, Tragedy Tonight

During the past 50 years we have seen many hopes dashed, but in retrospect they were unrealistic hopes. We simply cannot make use of coal without killing miners and polluting the air. Neither can we manufacture solar panels without worker fatalities and environmental degradation. (We assume that it will be less than with coal, but we are not sure.) We cannot build highways or canals or airports without despoiling the landscape. Not only have we learned that environmental dangers are inherent in every technological advance, but we are fated to be dissatisfied with much of what we produce because our tastes keep changing. The sparkling, humming, paved metropolises of science fiction—even if they could be realized—are not, after all, the home to which humankind aspires. Many people find such an environment "alienating." There can never be a technologically based utopia because we cannot agree on what form that utopia might take.

To express our disillusionment we have invented a new word: "trade-off." It is an ugly word, totally without grace, but it signifies the beginning of maturity for American society.

It is important to remember that our disappointments have not been limited to technology, a fact that the antitechnologists usually choose to ignore. Wonderful dreams attended the birth of the New Deal and later the founding of the United Nations, yet we have since awakened to face unyielding economic and political difficulties. Socialism has been discredited, as was laissez-faire capitalism before it. We have been bitterly disappointed by the labor movement, the educational establishment, efforts at crime prevention, the ministrations of psychiatry, and most recently the abortive experiments of the so-called counterculture.

Yet technology is still very much under society's control, an expression of our very human desires, fancies, and fears.

We have come face to face with *limits* that we had presumed to hope might not exist.

Those of us who have lived through the past 50 years have passed personally from youthful presumptuousness to mature skepticism at the very moment that American society has been going through the same transition. We have to be careful not to define the popular mood in terms of our personal sentiments, but I do not think I am doing that when I observe the multiple disenchantments of our time. We also have to be careful not to deprecate youthful enthusiasm, which is a force for good, along with immaturity, which is tolerable only in the young.

It can be argued that for a while there was good reason to hold out hope for utopia, since modern science and technology appeared to be completely new factors in human existence. But now that they have been given a fair trial, we perceive their inherent limitations. The human condition is the human condition still.

To persist in saying that we are optimistic or pessimistic about technology is to acknowledge that we will not grow up. I suggest that an appropriate response to our new wisdom is neither optimism nor pessimism, but rather the espousal of an attitude that has traditionally been associated with men and women of noble character—the tragic view of life.

As a student, I found it difficult to comprehend what my teachers told me about comedy and tragedy. Comedy, they said, expresses despair. When there is no hope, we make jokes. We depict people as puny, ridiculous creatures. We laugh to keep from crying.

Tragedy, on the other hand, is uplifting: it depicts heroes wrestling with fate. It is people's destiny to die, to be defeated by the forces of the universe, but in challenging their destiny, in being brave, determined, ambitious, resourceful, tragic heroes show to what heights human beings can soar. This is an inspiration to the rest of us. After witnessing a tragedy we feel good, because the magnificence of the human spirit has been demonstrated. Tragic drama is an affirmation of the value of life.

Students pay lip service to this theory and give the expected answers in examinations, but sometimes the idea seems to fly in the face of reason. How can we say we feel better after Oedipus puts out his eyes, or Othello kills his beloved wife and commits suicide, than we do after laughing heartily over a bedroom farce? Yet this concept, which is so hard to grasp in the classroom where students are young and the environment is serene, rings true in the world where mature people wrestle with burdensome problems.

The Technologist as Revolutionary

I do not intend to preach a message of stoicism: the tragic view is not to be confused with world-weary resignation. As Moses Hadas, a great classical scholar of a generation ago, wrote about the Greek tragedians: "Their gloom is no fatalistic pessimism but an adult confrontation of reality, and their emphasis is not on the grimness of life but on the capacity of great figures to adequate themselves to it."

It is not an accident that tragic drama flourished in societies that were dynamic—Periclean Athens, Elizabethan England, and the France of Louis XIV—for tragedy speaks of ambition, effort, and unquenchable spirit. Technological creativity is one manifestation of this spirit, and only a dyspeptic antihumanist can feel otherwise. Even the Greeks, who for a while placed technologists low on the social scale, recognized the glory of creative engineering—Prometheus is one of the quintessential tragic heroes. In viewing technology through a tragic prism, we are at once exalted by its accomplishments and sobered by its limitations. We thus ally ourselves with the spirit of great ages past.

The fate of Prometheus, as well as that of most tragic heroes, is associated with the concept of hubris, "overweening pride." Yet pride, which in drama invariably leads to a fall, is not considered sinful by the great tragedians. It is an essential element of humanity's greatness. It is what inspires heroes to confront the universe, to challenge the status quo. Prometheus defied Zeus and brought technological knowledge to the human race—he was a revolutionary. So were Gutenberg, Watt, Edison, and Ford. Technology is revolutionary. Therefore, hostility toward technology is antirevolutionary, which is to say, reactionary. This charge is currently being leveled against environmentalists and other enemies of technology. Since antitechnologists are traditionally "liberal" in their attitudes, the idea that they are reactionary confronts us with a paradox.

The tragic view does not shrink from paradox; it teaches us to live with ambiguity. It is at once revolutionary and cautionary. Hubris, as revealed in tragic drama, is an essential element of creativity; it is also a tragic flaw that contributes to the failure of human enterprise. Without effort, however, and daring, we are nothing. Walter Kerr has spoken of "tragedy's commitment to freedom, to the unflinching explora-

To persist in saying that we are optimistic or pessimistic about technology is to acknowledge that we will not grow up.

tion of the possible . . . At the heart of tragedy, feeding it energy, stands godlike man passionately desiring a state of affairs more perfect than any that now exists." This description of the tragic hero well serves as a definition of the questing technologist.

Hopeful Pessimism and Despairing Optimism

A particularly appealing aspect of the tragic view is its reluctance to place blame. Those people who hold pessimistic views about technology are forever reproaching others, if not individual engineers then the "technocratic establishment," the "megastate," "the pentagon of power," or some equally amorphous entity. Everywhere they look they see evil intent.

There is evil in the world, of course, but most of our disappointments with technology come when decent people are trying to act constructively. "The essentially tragic fact," says Hegel, "is not so much the war of good with evil as the war of good with good."

Pesticides keep millions of poor people from starving. To use pesticides is good; to oppose them when they create havoc in the food chain is also good. To drill for oil and transport it across oceans is good, since petroleum provides life-saving chemicals and heat for homes. To prevent oil spills is also good. Nuclear energy is good, as is the attempt to eliminate radioactive hazards. To seek safety is a worthy goal, but in a world of limited resources, the pursuit of economy is also worthy. We are constantly accusing each other of villainy when we should be consulting each other on how to best solve our common problems.

Although the tragic view shuns blame, it does not shirk responsibility. "The fault, dear Brutus, is not in our stars, but in ourselves." We are accountable for what we do or, more often, for what we neglect to do. The most shameful feature of the antitechnological creed is that it so often fails to consider the consequences of not taking action. The lives lost or wasted that might have been saved by exploiting our resources are the responsibility of those who counsel inaction. Thus, the tragic view is consistent with good citizenship. It advocates making the most of our opportunities; it challenges us to do the work that needs doing.

Life, it may be said, is not a play. Yet we are constantly talking about roles—role playing, role models, and so forth. It is a primordial urge to want to play one's part. The outlook I advocate sees value in many different people playing many different parts. A vital society, like meaningful drama, feeds on diversity. Each participant contributes to the body social: scientist, engineer, farmer, craftsperson, laborer, politician, jurist, teacher, artist, merchant, entertainer. The progrowth industrialist and the environmentalist are both needed, and in a strange way they need each other.

Out of conflict comes resolution; out of variety comes health: this is the lesson of the natural world. It is the moral of ecological balance; it is also the moral of great drama. We cannot but admire Caesar, Brutus, and Anthony all together. So should we applaud the guardians of our wilderness, even as we applaud the creators of dams and paper mills. I am a builder, but I feel for those who are afraid of building, and I admire those who want to endow all building with grace.

George Steiner, in *The Death of Tragedy*, claimed that the tragic spirit was rendered impotent by Christianity's promise of salvation. But I do not think that most people today are thinking in terms of salvation. They are thinking of doing the best they can in a world that promises neither damnation nor transcendent victories, but instead confronts us with both perils and opportunities for achievement. In such a world the tragic spirit is very much alive. Neither optimism nor pessimism is a worthy alternative to this noble spirit.

We use words to communicate, but sometimes they are not as precise as we pretend, and then we confuse ourselves and each other. "Optimism," "pessimism," "tragic view"—these are mere sounds or scratches on paper. The way we feel is not adequately defined by such sounds or scratches. René Dubos used to write a column for *The American Scholar* that he called "The Despairing Optimist." I seem to recall that he once gave his reasons for not calling it "The Hopeful Pessimist," although I cannot remember what they were. What really counts, I suppose, is not what we say, or even what we feel, but what we want to do.

By saying that I espouse the tragic view of technology, I mean to ally myself with those who, aware of the dangers and without foolish illusions about what can be accomplished, still want to move on and actively seek to realize our constantly changing vision of a more satisfactory society. I mean to oppose those who would evade harsh truths by intoning platitudes. I particularly mean to challenge those who enjoy the benefits of technology but refuse to accept responsi-

"Trade-off" is an ugly word, totally without grace, but it signifies the beginning of maturity for American society.

bility for its consequences.

I would like to close by quoting the last few lines from my much-rewritten opus for *House & Garden*. The prose is somewhat florid, but please remember that it was written in celebration of the American bicentennial:

"For all our apprehensions, we have no choice but to press ahead. We must do so first in the name of compassion. By turning our backs on technological change, we would be expressing our satisfaction with current world levels of hunger, disease, and privation. Further, we must press ahead in the name of the human adventure. Without experimentation and change our existence would be a dull business. We simply cannot stop while there are masses to feed and diseases to conquer, seas to explore and heavens to survey."

The editors of *House & Garden* thought I was being optimistic. I knew that I was being tragic, but I did not argue the point.

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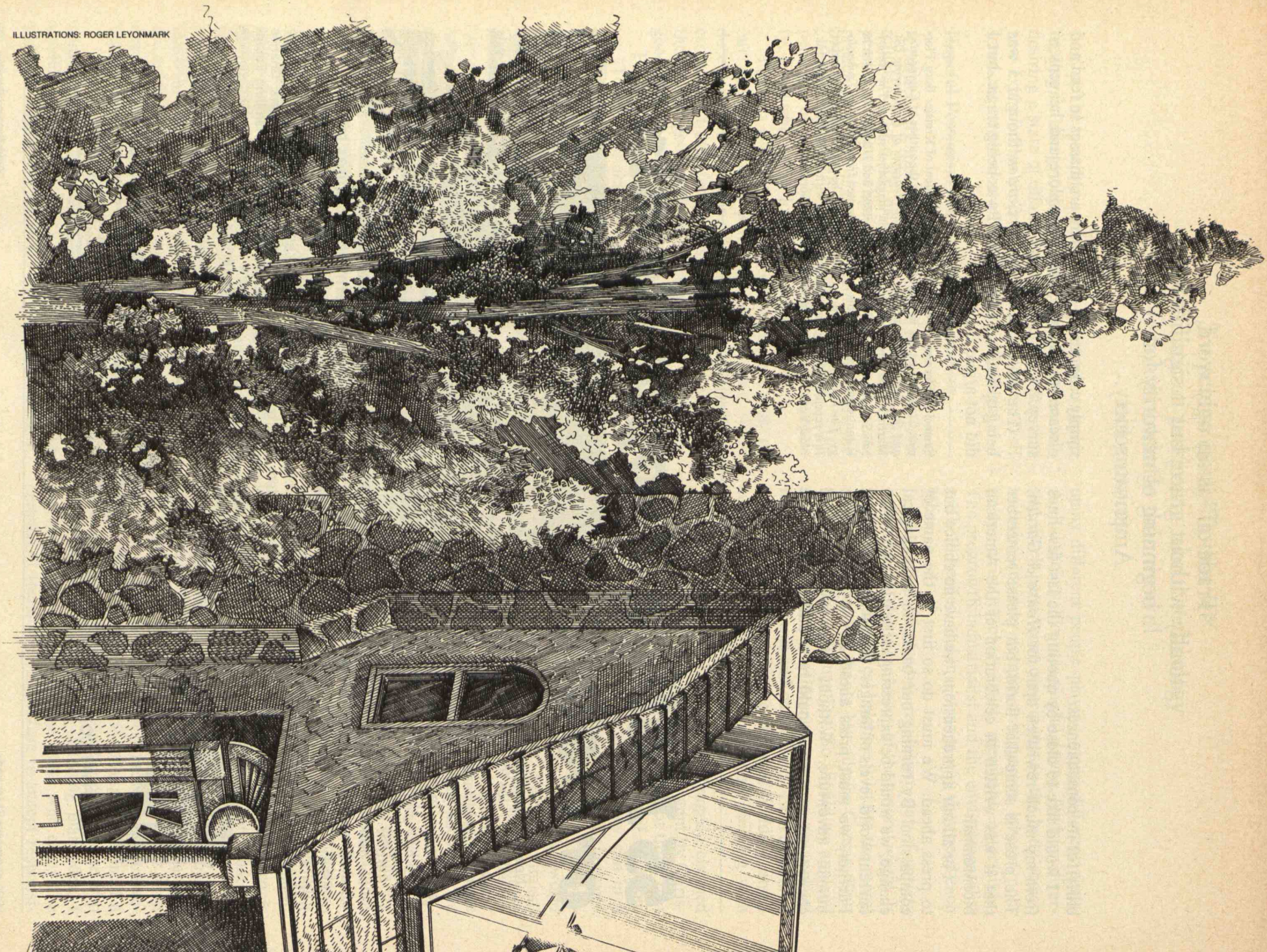
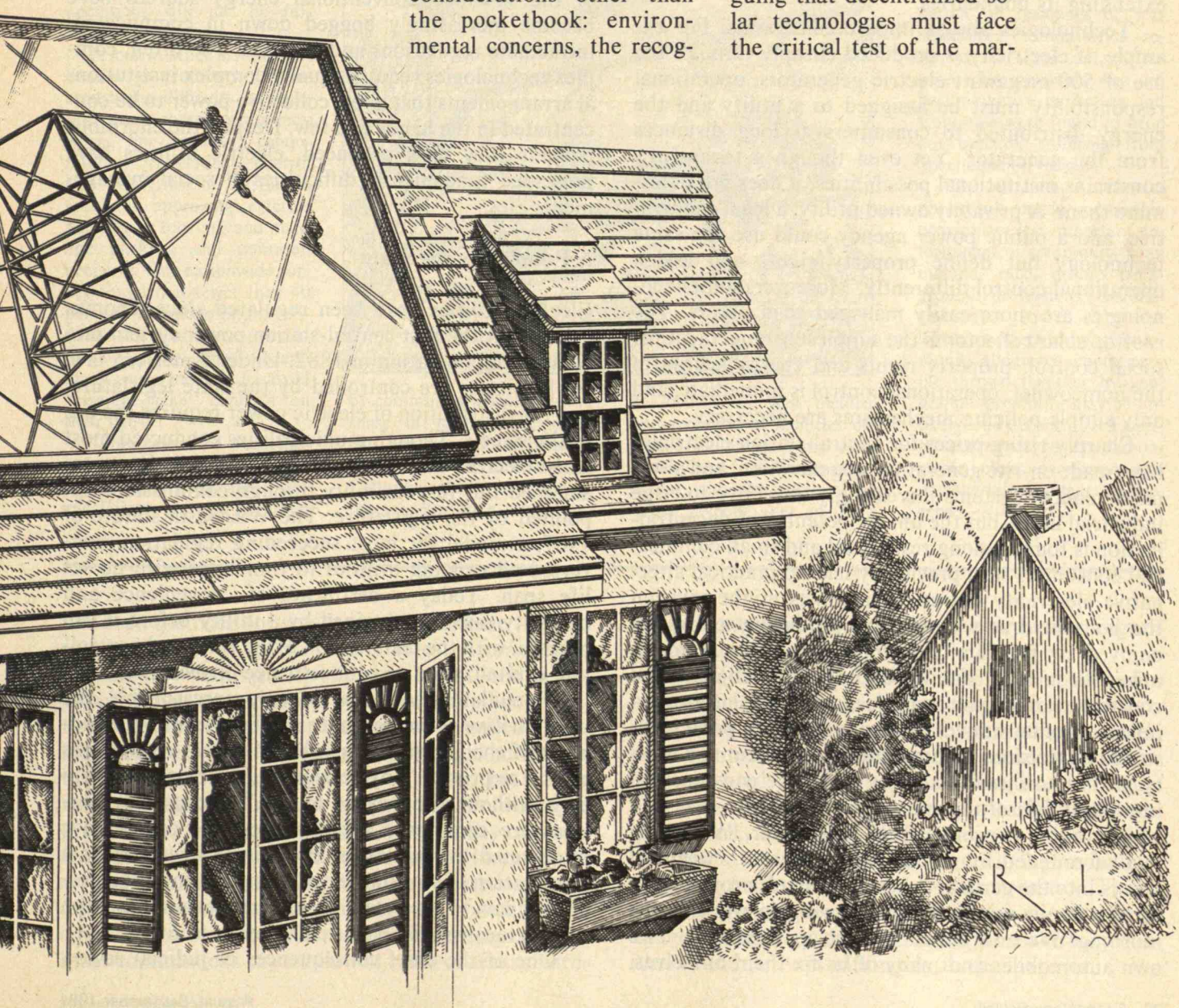


Power to the People: The Promise of Decentralized Solar

by Robert W. Gilmer

MANY people who have adopted decentralized solar devices for their home or business have undoubtedly been motivated by considerations other than the pocketbook: environmental concerns, the recognition that fossil-fuel resources are finite, or a search for self-reliance. But critics often dismiss these solar pioneers as an elitist fringe, arguing that decentralized solar technologies must face the critical test of the mar-



The appointment of a public body to negotiate rates and exert other controls over a utility is not a panacea for monopoly.

ketplace largely on the basis of cost. Although relative cost is important, decentralized solar technologies offer further advantages in the social control of energy, the institutional arrangements that link the energy producer and consumer.

Because solar technologies give small energy consumers the chance to cut ties to an outside supplier—a public utility—they offer the prospect of relief from many of the social burdens of planning, regulating, and allocating the future energy supply. In other words, decentralization involves integrating the energy supplier into the firm or household, analogous to the decision of a firm to vertically integrate by extending its boundaries.

Technologies always impose constraints. For example, if electricity is produced cheaply through the use of 500-megawatt electric generators, operational responsibility must be assigned to a utility and the energy distributed to consumers at long distances from the generator. Yet even though a technology constrains institutional possibilities, it does not determine them. A privately owned utility, a local cooperative, and a public power agency could use the same technology but define property rights and assign operational control differently. Moreover, some technologies are more easily managed than others. The rooftop solar collector is the simplest arrangement for social control: property rights and energy accrue to the homeowner, operational control is immediate, and only simple policing mechanisms are necessary.

Sharply rising prices for central-station electricity have made on-site generation, cogeneration, and alternative energy systems increasingly attractive to large industrial users, but the unique potential of decentralization is found among residential and small commercial consumers who previously had no practical alternative electricity source. Economists might envision the household as a small firm producing a lifestyle enjoyed by the family members: the former maximizes the joint satisfaction of the family subject to the constraints of income and prices, while the latter maximizes profits subject to technical and price constraints. Decisions by households to connect to a utility grid or to insulate already make the consumer an important part of the energy business.

According to economist W.J. Liebeler, "We are in fact surrounded by vertical integration . . . weekend forays into the garden, the do-it-yourself project to fix up the family room, or even driving to work in the morning. We own houses or rent apartments . . . we own automobiles and many of us fix them ourselves, at least to some extent. Some of us are decently accomplished plumbers, electricians, carpenters, and even masons. The notion that vertical integration is somehow vaguely antisocial in nature is not consistent with the widespread occurrence of [these] apparently benign examples." When viewed from this perspective, the issue of decentralization becomes a decision between making and buying energy—between remaining on the utility grid or vertically integrating to produce the energy supply within the household.

Thus, the institutional ties of some technologies are easily managed, while others may require an extraordinary investment of time and resources. Most of the so-called conventional energy sources have become increasingly bogged down in complicated, intractable regulations and controls. Too often, complex technologies require equally complex institutional arrangements that allow collective power to be concentrated in the hands of a few. Despite the enormous benefits they have produced, electric utilities have presented fundamental difficulties of social management.

A Promise by the State

Electric utilities have been regulated since Thomas Edison put the first central-station power system into commercial operation in 1882. Under American law, public streets are controlled by the state legislature, and the distribution of electric power requires the use of the streets. Though municipalities conducted most early electric utility regulation, by 1914 the states assumed this responsibility through commissions appointed by the legislature. The Wisconsin statute of 1907, a model for most succeeding regulation, converted all existing utilities to franchises with no set life span. Today a certificate of convenience and necessity must be obtained by a utility before it can operate, with the commission fixing rates and controlling capitalization and the issuance of securities.

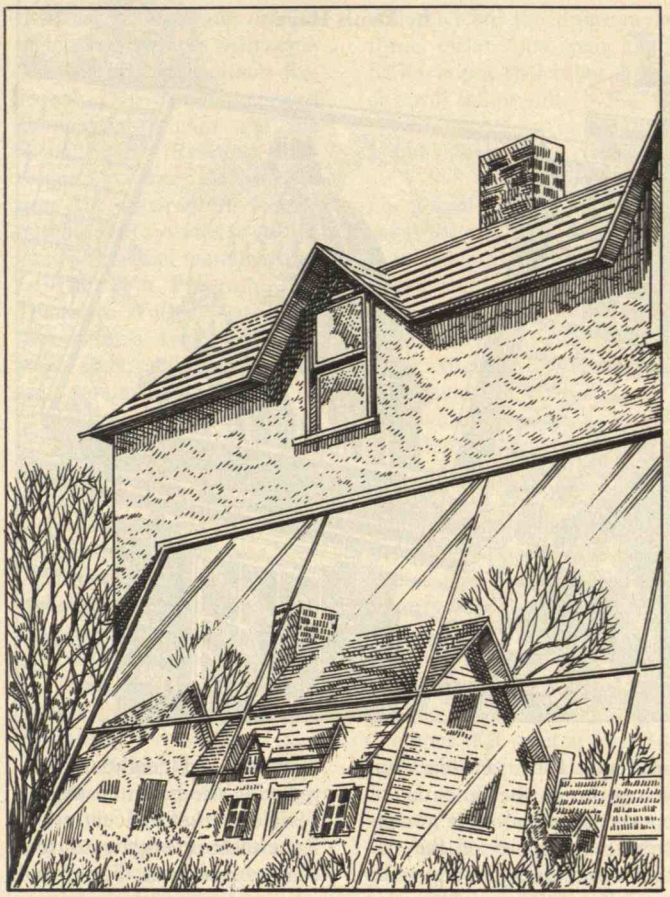
If regulatory sanctions become unreasonable, the utilities have recourse under the Fourteenth Amendment of the Constitution, which imposes restrictions against depriving "any person of life, liberty, or property, without due process of law." Because corporations are considered legal entities, the courts have interpreted the setting of excessively low rates as a confiscation of stockholder property without due process of law. This access to judicial review has been used extensively by electric and other utilities.

One of the chief consequences of judicial review

Local Control and Grass-Roots Democracy

THE simplified flows of information between producers and consumers and the greater responsiveness of local management are often cited as advantages of decentralized energy production. Success depends on the willingness and ability of neighbors to make participatory democracy work. However, if local energy production is supposed to promote the social goals of the community because residents spontaneously join together in energy production, such expectations will not be fulfilled.

A look at other private residential governments demonstrates the difficulty of making grass-roots democracy work. For example, condominium associations control the activities of residents (such as approving exterior painting or fencing) and manage parking and common property. One nationwide survey found that fewer than 40 percent of condominium residents felt that their association was doing a good job, and many were moving to avoid "straight-jacket controls on their lives."



"New towns," a phenomenon of the late 1960s largely considered a social and financial failure, are also governed by community associations. A sense of local participation and control was deliberately promoted in the new town of Columbia, Md., with industry, transportation, educational institutions, and medical and recreational facilities designed to integrate the community and free it from interaction with the surrounding urban society. Yet in 1973 only 39 percent of the residents of Columbia had attended even one meeting of their community association. The attendance figures for the new towns of Jonathan, Minn. and Reston, Va. were 31 percent and 32 percent, respectively, with fewer than 10 percent of the residents reporting complete satisfaction with their association.

A comparison of community and civic activities in the new towns of Columbia and Reston with the civic participation of residents of less structured communities revealed no significant differences. The residents who did become active in Reston and Columbia were found to drop out quickly, suffering from "participation fatigue."

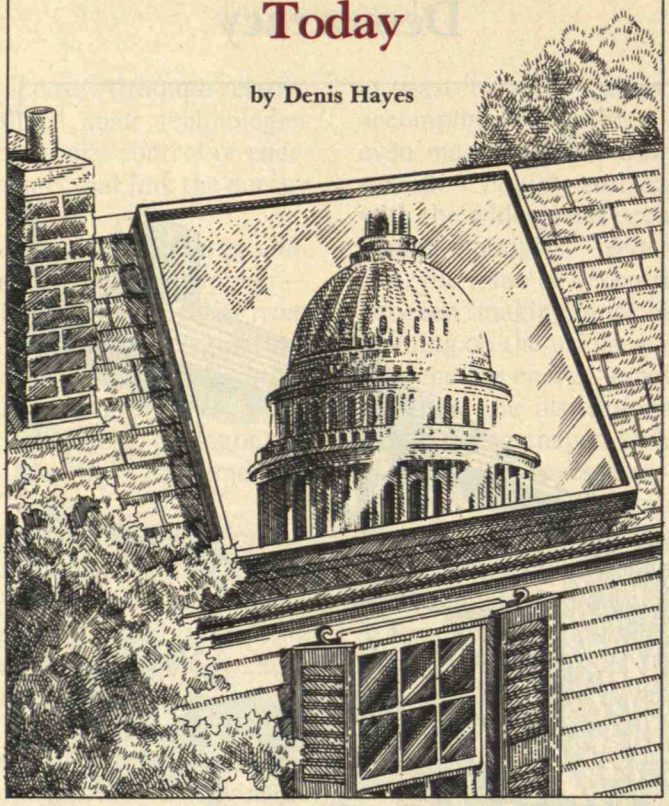
The automobile and telephone have made geographic proximity a less important determinant of community than income, race, ethnic background, professions, hobbies, and other shared interests. Thus, an effort to foster community allegiance among people thrown together by geographic proximity may be unlikely, and decentralized energy sources will have to demonstrate clear economic and managerial advantages to succeed.—*R.W.G.* □

has been the need for standards to determine the reasonableness of of public utility rates. After several decades of wrestling with slippery issues, such as historical versus reproduction costs and "true" depreciation, the courts have settled on the so-called "end-result concept." This does not require rigid adherence to a particular formula or rate of return but rather requires that the financial integrity of the utility be preserved. This is accomplished if the utility can hold and attract the new capital necessary to maintain its service standards, meaning that most regulatory commissions now valuate liabilities instead of assets. This emphasis on stocks, bonds, and their earnings has led most commissions to set allowed rates of return within a percentage point or two of the average earnings of industrial securities.

Thus, the law recognizes the preservation of a utility's financial integrity as a duty, one largely carried out by customers through higher rates. However, new, competing technologies may cause demand for the regulated commodity to decline, and the state may have to find more direct means to fulfill its legal obligations. Passenger railways and urban public transportation are examples of declining industries with direct subsidies from the public treasury. Therefore, the guarantees to the utility shift the burden of financial risk from the investor to the electricity consumer, and perhaps ultimately to the taxpayer.

Fulfilling the Solar Promise Today

by Denis Hayes



At the dedication of the solar water heating system atop the White House in 1979, President Carter established a goal of obtaining 20 percent of the United States' energy from renewable resources by the year 2000. This was the culmination of a year-long review of the federal solar program involving some 30 federal agencies. However, in spite of the considerable fanfare, no coherent legislative program has been introduced, let alone enacted, to achieve this ambitious goal.

There is now little question that the nation has the technical resources to meet the 20 percent solar goal; the only uncertainty is whether we have the political will to encourage the solar industry. Building upon the existing patchwork of legislation, the new administration can, without large public expenditure, create a public-sector/private-sector marriage capable of sparking rapid growth in the utilization of solar resources.

The Solar Stepchild

U.S. energy policy has historically been one of crisis management, with a marked tendency for our national institutions to rely on past solutions. Consequently, when the Energy Security Corporation was established in 1980 with $88 billion in loan authority, the preponderance of funding was devoted to the production of synthetic oil and gas from coal and shale. Little consideration was given to the potential of conservation and solar to contribute far more of the nation's total energy budget for a smaller investment. Legislation to promote efficiency and renewable energy technologies has often been a stepchild to other legislation; one important solar law was introduced as a rider to a bill regulating the import of antibiotics.

The time has long since come to pursue the solar option on its own merits. Solar energy systems are readily adaptable to ownership by individuals and neighborhoods, reducing the potential for excessive market concentration. Renewable energy resources can provide heat, liquid and gaseous fuels, and electricity, and no other near-term energy resource affords a realistic promise of cost reductions and continuity of supply. Technologies to harness the energy in wind, water, biomass, and direct sunlight add no heat to the global environment and produce no radioactive or weapons-grade materials. And unlike conventional technologies, the solar option gives initiative and responsibility to entrepreneurs and consumers rather than centralized bureaucracies.

A Battelle Institute study in 1978 found that oil, gas, coal, nuclear, and hydropower have been subsidized by a total of $220 billion, with most of this money going to production incentives. Only in the last few years have similar federal incentives been available for those who wish to invest in renewable resources, and those incentives tend to be haphazard and inconsistent. Moreover, most people are unaware of the wide range of opportunities for individual action.

Solar Tax Credits. A 40 percent solar tax credit on investments of up to $10,000 is available to homeowners who purchase qualifying solar equipment, including wind turbines and photovoltaic arrays. Some states offer additional tax credits, and businesses that utilize solar in manufacturing qualify for a 15 percent increase in the investment tax credit. A tax credit to encourage builders to include passive features was adopted by the Senate in 1979 but failed to pass the House.

Financing Incentives. The loan ceilings of the Federal Housing Administration and the Veterans' Administration have been increased to encourage the addition of solar systems. The Small Business Administration has also earmarked several hundred million dollars for loans to solar

The Electricity Contract

How are consumers to decide between relying on an outside supplier and becoming their own energy producers? Why is a deliberate choice made to purchase some inputs and to produce others? In competitive markets, the actions of large numbers of firms are coordinated by the mechanics of demand and supply. If a formal contract were necessary for each factor of production, and if these contracts had to be renegotiated with every change in the work flow, the costs in time and effort would be enormous. But as a firm grows, central direction from top levels becomes more remote and efficiency declines. The firm tends to vertically integrate into areas where it is expensive (in time, money, or the assumption of risk) to negotiate the purchase of inputs on the open market; it will rely on the market and other suppliers if it can conclude a

businesses and conservation companies. In addition, the new national Solar and Conservation Bank, if funded by Congress, will have $125 million for long-term, low-interest loans this year for moderate- and low-income households.

Regulatory Activities. The Public Utilities Regulatory Policy Act requires utilities to buy electricity from small producers at the utility's cost of supplying that power from conventional sources. This has prompted a new industry to form specifically to sell electricity to utilities. Also, the Regional Conservation Service requires utilities, under the supervision of the states, to assess opportunities to conserve energy and utilize solar in customers' homes. More recent legislation would permit utilities to arrange or provide financing for such investments. And although the Energy Conservation and Production Act of 1974 established mandatory energy performance standards for all new residential and commercial structures, implementation has been deferred.

Government Purchases of Solar Systems. The annual military construction authorization bill requires that all new military housing and 25 percent of other new facilities utilize a mix of solar systems where cost-effective. This simple requirement has resulted in $100 million to $150 million in annual revenues for the solar industry and provided local contractors with experience. The Photovoltaics Research, Development, and Demonstration Act and the Wind Energy Research, Development, and Demonstration Act also require federal purchases of systems to stimulate commercial manufacture.

The TVA Program. The Tennessee Valley Authority, the nation's largest electric utility, has established a program to install thousands of residential solar water heaters in Memphis, Nashville, and rural areas with subsidized loans. The TVA is working with manufacturers to design inexpensive passive solar prefabricated homes and has established a revolving fund for the design and construction of site-built passive solar homes. The TVA also provides interest-free loans for wood-burning stoves.

The Solar Homebuilders' Program. The Solar Energy Research Institute (SERI) paid the architectural fees for a dozen Denver builders to convert basic home types to solar homes. These solar improvements increased the construction cost of an average home by about 5 percent while reducing its energy requirements for heating and cooling by 80 percent. More than 100,000 prospective customers toured the 12 houses and placed orders for about $8 million worth of additional new solar houses. The Bonneville Power Administration will replicate the program in three cities this year, and SERI hopes that other agencies will follow suit.

Local Efforts

Local and private initiatives usually have a better record than government programs. Because they must live with the consequences, individuals are often more careful—and more successful—than bureaucracies.

Two community-scale efforts deserve serious attention. The municipal utility serving Palo Alto, Calif., furnishes a comprehensive energy survey and information on solar energy and conservation to homeowners. Local contractors then install insulation with payback through the utility billing system. The utility also provides a 10 percent discount to homes that meet at least 50 percent of their domestic hot-water and swimming-pool heating needs with solar.

Another successful local effort is Village Homes, a 70-acre subdivision in Davis, Calif. (*see "Village Homes: A Solar Suburb," by Richard Albert, Jr., July, p. 12*). Village Homes features passive and active solar designs, limited automobile access, ample bicycle paths, an ambitious community gardening program, and materials recycling.

But although the private sector is underwriting much engineering design and product development, ground-breaking solar research—like so much other research—requires a patron for whom a vision is more important than this year's bottom line.

Some federal solar research programs are poorly managed, and a few—for political reasons—may be funded at higher levels than justified by their technical promise. Moreover, the solar program has a record of funding dead-end research and gold-plated, nonreplicable pilot plants.

But most solar programs are funded much more modestly than they require, and again in fiscal 1982, solar technologies will receive only about 2 percent of the energy-related portion of the Department of Energy's budget. Some of the most exciting fields receive so little support that history seems certain to view our short-sightedness with incredulity. For example, the budget for photochemistry, photoelectrochemistry, and photobiology could easily be increased fivefold without fear of waste.

The solar potential is immense. And although the new administration seems to move in strange ways along this path, we must somehow ensure that the promise is fulfilled. □

Denis Hayes is the former director of the Solar Energy Research Institute in Golden, Colo. This article is adapted from a paper presented to the AAAS in Toronto.

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comparatively flexible, riskless agreement with minimal negotiation. The limits of the firm and length of its supply chain are determined by weighing one cost against the other.

When and why would the cost of continued negotiation for the delivery of electricity become too high? Consumers may consider the purchase of electricity similar to other everyday transactions such as the purchase of gasoline, clothing, and groceries. But consider the comparative ease of buying a tank of gasoline:

□ No precedent relationship is necessary between the service station and the customer; there is a choice of both brand name and station.

□ No future relationship is necessary between the service station and the customer; once the bill is paid and the customer leaves the premises, the transaction is over.

□ The purchase is short, limited in scope, and large-

The promise of decentralized solar may rest simply on the control of energy as an individual rather than a social responsibility.

ly impersonal; it is unnecessary to inquire into the petroleum business.

The simplicity of this transaction contrasts sharply with the continuing relationship of electricity consumers with producers and the complex controls over the electric utility industry, which require the continual reporting of large amounts of information. Perhaps the most striking aspect is the small number of active participants, with utility management representing a passive group of stockholders and the public commission representing a passive group of consumers.

But the appointment of a public body to negotiate rates and exert other controls over a utility is not a panacea for monopoly. The state commission, acting in the consumer's interest, avoids time-consuming negotiation of many individual contracts. However, typical small residential or commercial consumers may find the commission inaccessible and their indirect influence through the legislature and the consumer movement only rarely consequential.

The design of a nuclear reactor for bulk generation, the economics of mine-mouth, coal-fired generation, the design of a transmission corridor, and the floating of a new bond issue all require special expertise. Assessing whether the highly technical functions required to generate and distribute electricity are carried out in the public interest requires continual involvement, not the hallmark of most public utility commissions. Staffs are small, the number of affected utilities great, and the time available to probe the inner workings of the utility industry limited, so commissions have historically sought to avoid legal proceedings and to limit formal hearings. And although consumer and environmental groups, as well as external events such as the Arab oil embargo, have recently forced a more active role upon utility commissions, much of the information they require remains the property of the regulated industry.

Persistent inflation, stringent environmental controls, and soaring fuel costs, coupled with slower economic growth and diminished scale economies, forced electric utilities to petition commissions for rate increases continually in the early 1970s, and the entire review process was near breakdown. Three new administrative strategies were developed to deal with this problem: temporary rate increases, automatic fuel adjustments, and future test years. These tools, a concession to the commissions' limited understanding in the face of rapid social, environmental, and economic change, compromise their review powers.

The Consumer's View

Because energy fills basic physiological requirements for warmth, cooking, and sanitation, the choice among alternative energy supply systems can affect what social psychologists term the "safety need" of consumers for an understandable, well-ordered situation. In the hierarchy of needs developed by Abraham Maslow, unmet safety needs may threaten social interaction, self-esteem, and self-actualization. Thus, an energy supply system should be stable and unobtrusive.

In the past, the monthly electric bill rarely contained unexpected news, as the unit cost of electricity fell steadily from the inception of the electric utility industry through the 1960s. The formula for operating a successful electric utility was perfected early by Samuel Insull and widely imitated: build load, capture scale economies to reduce cost, cut the price of electricity to build new load, and begin the process again. Because lags in the regulatory review process generally kept rates well above operating costs, utility profits were high, but this open-ended process has ended.

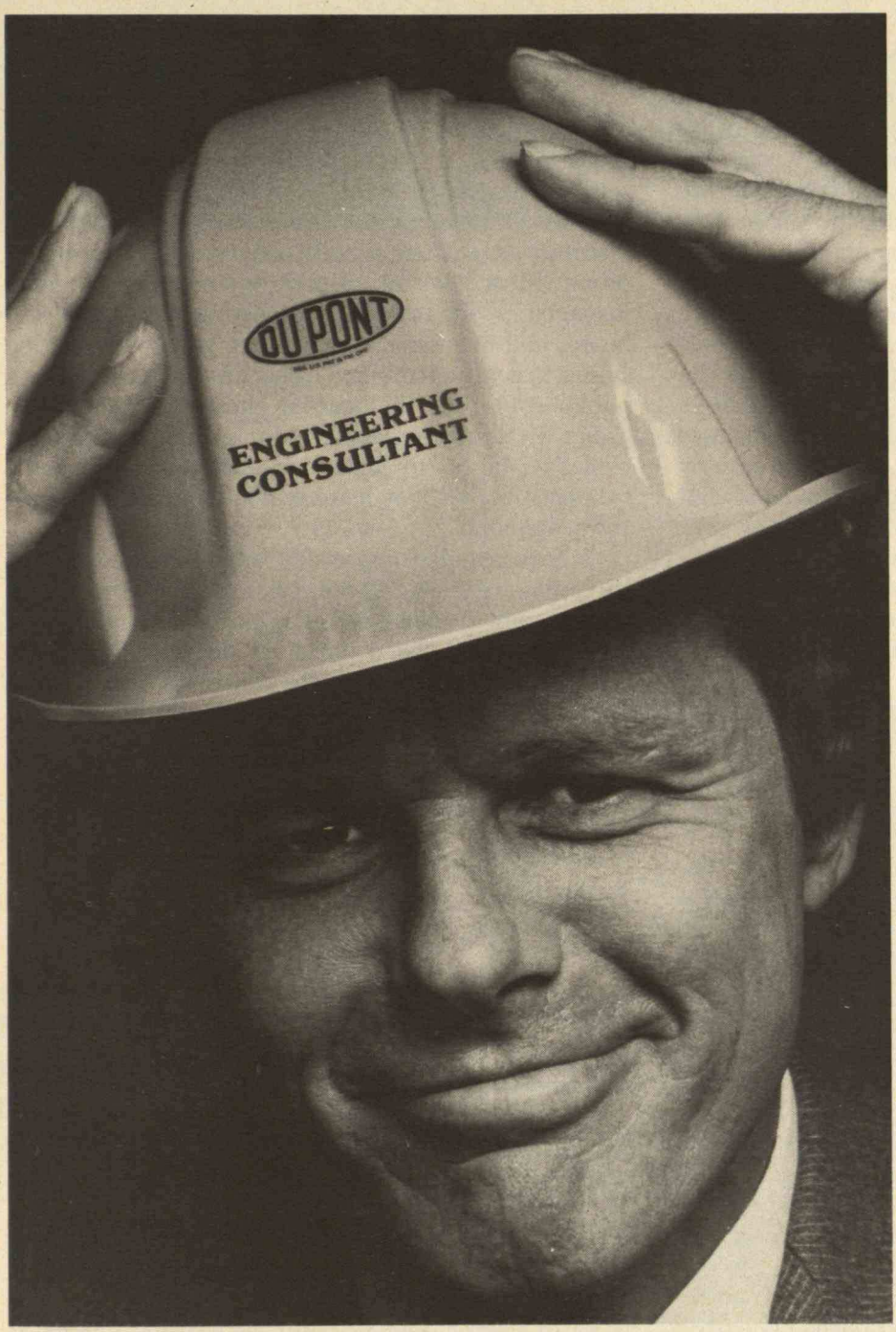
Now that economic and environmental impacts have slowed or reversed the technical and economic advances of the utilities, the difficulty of assuring adequate social control has become critical. From the consumer's viewpoint, the choice between central-station electric generation and decentralization with solar devices boils down to the following:

☐ Sign a contract for the long-term delivery of electricity. Investments will be made in the consumer's behalf by the utility, with both capital and operating costs financed by a consumption charge. The rate is set through continuing negotiations in which the utility has many advantages.

☐ Make a single capital investment in an alternative energy system and assume responsibility for monitoring and maintaining it. The cost of energy may or may not be lower, but the cost is certain.

Widespread adoption of the second option could preclude the first. The decision to use centralized power implies a long-term faith in the willingness and ability of the utility to deliver energy. However, both the size and the duration of the individual consumer's commitment are small compared with the commitment of the utility, which must assume operations of 20 to 30 years to recover its investment. A long-term commitment by sufficient numbers of consumers to capture the economies of large-scale operations is

Put on a new career



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implicit. If consumers begin to rely on solar and small-scale backup systems, the ability of the utility to deliver electricity could be questioned. More consumers might conclude that vertical integration into the energy business is the best option, and the process would snowball (*see "Solar Heating and the Electric Utilities" by Modesto Maidique and Benson Woo, May 1980, p. 24*).

Aside from cost considerations, the only obvious disadvantage of decentralized solar is upkeep on the equipment, one more set of routine chores to be done around the house. But if householders find maintenance of energy systems a bother, they can employ small, competing firms that spring up to build and install these systems and maintain them under contract. No regulations beyond existing zoning, licensing, and safety and health restrictions would be necessary, and these competitive energy-management firms would offer freedom from the home energy system without loss of control.

Neighborhood Control

The rooftop solar collector offers the simplest social control of energy, but other energy generators, such as windmills and solar ponds, can be scaled to the block or neighborhood level for perhaps 12 to 100 homes. Vertical integration is less complete than for the rooftop collector, but supply lines can be greatly shortened. This gray area between the smallest and largest of generators poses the greatest challenge to institutional innovation.

Of course, central utilities could build and operate ponds or windmills, monitor the heat or electric flow to each customer, and set service standards and rates, but utilities would tend to favor larger-scale, complex systems and squeeze out innovative regional designs. Consumer control and social diversity would receive little or no weight in the planning process.

Standard legal arrangements for cooperative home ownership provide a pattern for neighborhood control of energy production. Each household becomes a shareholder in a nonprofit corporation, which acquires the land, builds the generators, and connects the household to it. The cooperative offers most financial advantages that accrue to property owners, such as income tax savings through depreciation, and deduction of interest on the mortgage based on the percentage of stock held. The Federal Housing Administration has insured loans to such cooperative corporations since 1950.

The household agrees to the equivalent of a utility tariff, which could limit the household's seasonal share of heat as well as determine the character of service, provisions for late payment, and other administrative matters. Bylaws are written and a board of directors are elected, usually serving without compensation. Most housing cooperatives are professionally managed by an individual reporting directly to the board, and maintenance of energy generators can be similarly contracted. Such a cooperative is similar to a public utility, but the board is chosen from a smaller group with common goals and interests, and an individual's ability to influence decisions is greatly enhanced because top management consists of friends and neighbors.

I have avoided appeals to environmental ethics, antitechnology arguments, the possible threats of nuclear power, and several important economic issues. However, the promise of decentralized solar energy may rest simply on the control of energy as an individual rather than a social responsibility.

Robert W. Gilmer is a public-sector economist at the Institute for Energy Analysis at Oak Ridge Associated Universities in Oak Ridge, Tenn. He received his Ph.D. from the University of Texas at Austin. This article reflects work performed under contract for the U.S. Department of Energy, but the views are strictly those of the author.

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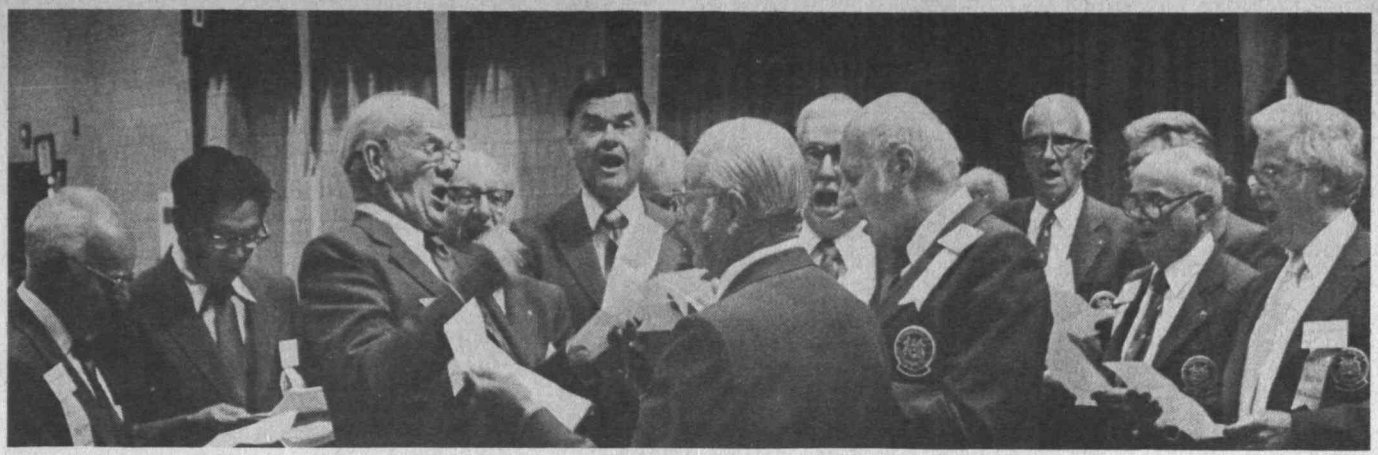

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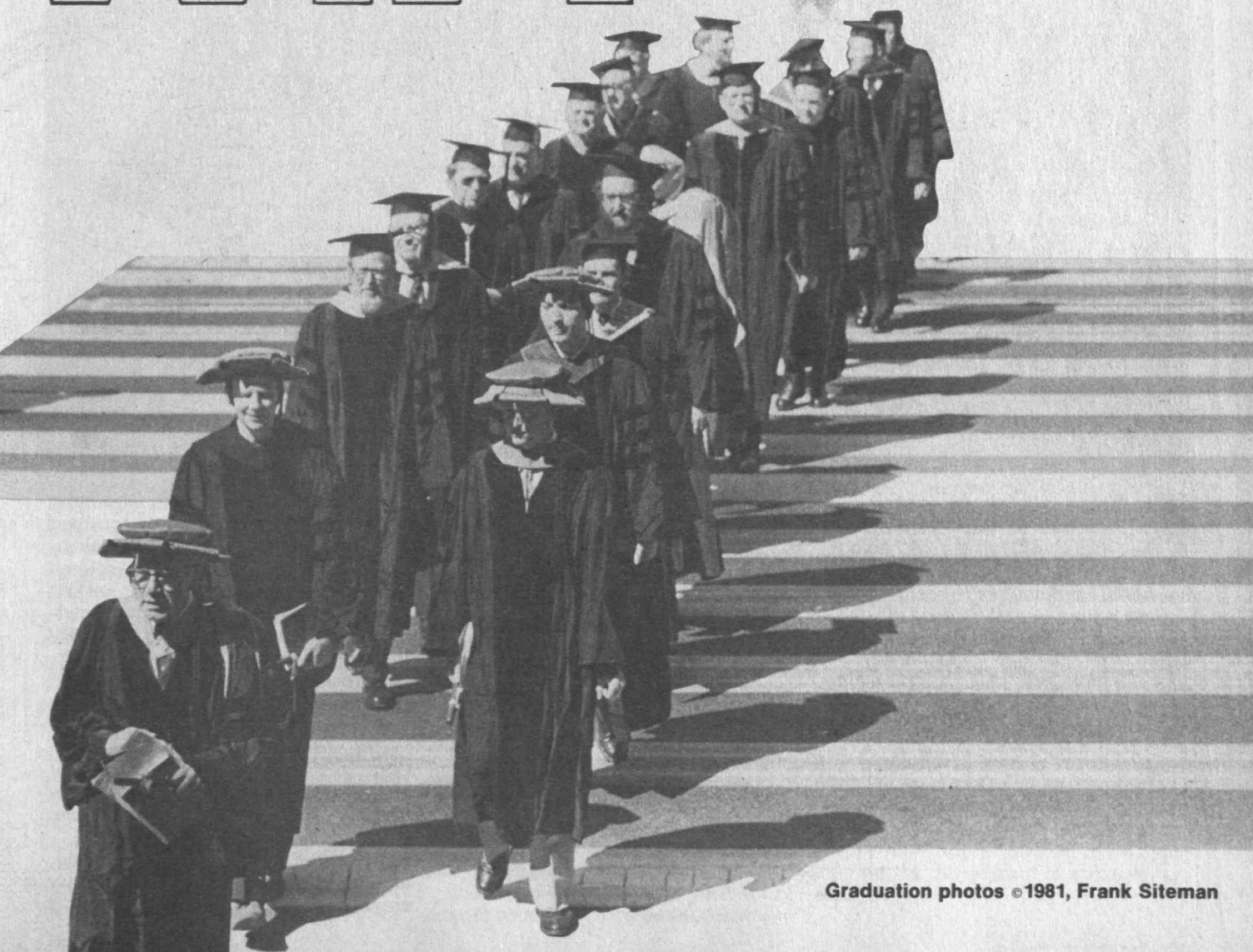


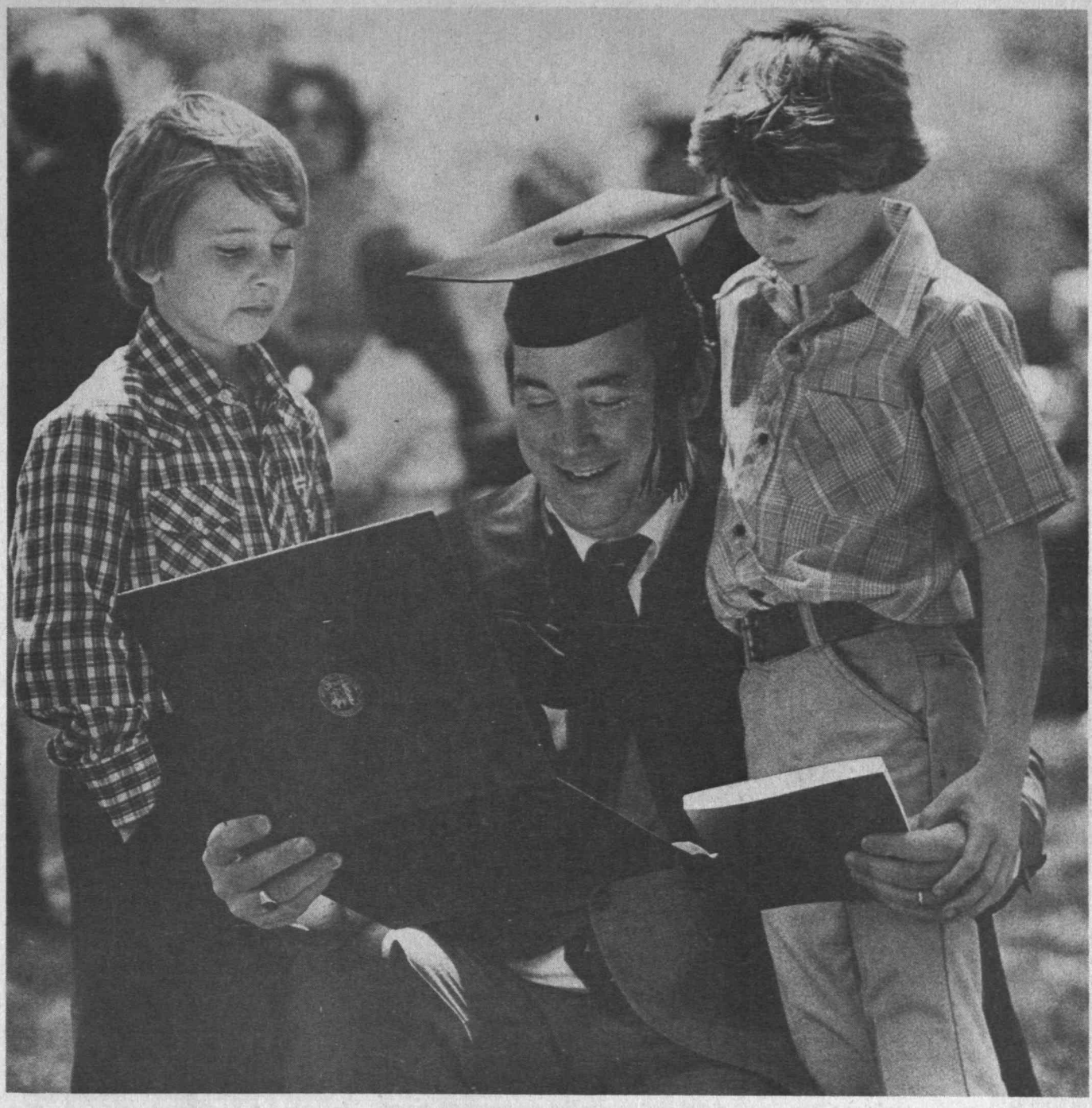
Cover, top:
Sung to the tune of "Arise Ye Sons" by the Class of 1931 at the Technology Day luncheon: "Ken's squeezed and squeezed/ and now we're set/ to bring you his report. For confidence in setting goals/ you must not sell him short./ The total sum is staggering/ and you must look alive!/ to figure out it's thirty-one times ten/ raised to the five." (Photo: Calvin Campbell)

Graduation: Step Forward, Now, to Contribute to a Better World

Events of the day are hectic and moving, pomp and circumstance touching even the most stoic. The 77 Massachusetts Avenue pillars form a solemn backdrop for a brass band nestled there, the white vertical columns dwarfing the players while seeming to amplify the clear stirring sounds of their music. The freshness of the day tingles with expectation, and hurrying, bustling, jostling crowds fill buildings 7 and 10.

The vast expanse of chairs in Killian Court is spottily filled by 9:00; an hour later the grass is obliterated from view by a carpet of brightly dressed people: proud parents, relatives, and guests.

After the procession, the welcome, and the singing, the invocation by Reverend Swami Sarragatananda, in a



voice whose lilting sound goes beyond words, creates a prayer to touch everyone: "Let us be united. Let us speak in harmony. Let our minds apprehend alike."

The large numbers—degrees awarded to 1,515 students in front of an audience of 5,000—mask the individual impact each degree has on its holder; how his or her future will be molded by that degree.

The fabric of life is an intricate design, woven with threads of different origins, different weights, different hues. One brightly colored and delicately interwoven thread is made from one's education. It permeates the whole: good friends are made in that institution, often retained for a lifetime through common interests and an important common experience. A career is begun—perhaps to change and evolve but always to retain as its foundation a way of thinking fostered and nurtured in M.I.T.'s classrooms. Knowledge is gained here—and perhaps most important, a concern with the world and a willingness to use the skills acquired at M.I.T. to contribute to the well-being of the people that inherit that world.

President Gray emphasized this concern in his address:

"Can you—will you—strive to create and defend the principles of open inquiry and open communication—wherever you are, whatever you do?

"Can you—will you—put your M.I.T. education to work for a better society—wherever you are, whatever you do?

"Can you—will you—take direct care and responsibility for the welfare of other human beings—wherever you are, whatever you do?

"I believe you can. I believe you will. It is time."

The paths that they take after this graduation day differ widely. And at times they depart radically from their original career choices. But the bearer of the diploma takes with him or her an association with M.I.T. that is respected throughout the world and has the power to open countless doors—a power that is often more appreciated 25 years later than on the day when it is acquired.—*M.L.*

Graduation Is No Small Do; Preparation Is a Herculean Task

Planning for it is like the countdown for a blast off.

Every piece of construction, every direction for hundreds of personnel involved, every minute detail must be thoroughly handled in sequence, on time, or the careful preparation march topples like dominoes. Even a small error courts disaster.

The mastermind is Henry J. Leonard, superintendent for support .services who shares responsibility with Mary Morrissey, director of information services, and the commencement committee. A small sample of concerns taken from Hank's "bible" smacks of military precision: power, lighting, stage, rostrum, audio visual towers, canopy, carpet, band section, stage decorations, signs (approximately 110 of them), musical instruments, chairs, programs, diplomas, Mace, fire extinguisher, M.I.T. seal, public address system, ushers, batons and rosettes . . .

When, where, who. Times are precisely planned: "On Thursday, May 28, at 8:00 a.m., Jackson Chairs will deliver 1,500 number 22 Samsonite chairs to Killian Court. Ocean State Rental will deliver 5,000 number 22 Samsonite Chairs at 10:00 a.m. . . . See seating plan number CDK81-01. The chair set-up is to be completed by Friday, May 29."

"Where" is mapped on architectural drawings, "who" is assigned to various people responsible for each facet of the job. "For the final two months, commencement takes priority for every foreman we have on the physical plant staff," says Mr. Leonard. And over 500 workers are involved. No detail is too small to be included: "A red color venetian blind tape will be stapled to the carpet at the locations shown on drawing number CDK81-02."

"Planning starts way in advance, around January," explains Mr. Leonard, "but we really get in gear April 1. Then plans are finalized, tasks assigned, backup strategy developed. (An entire scenario, indoors in the new athletic

facility with a drastically different procedure is ready to roll should it rain.) By the last three weeks in May, construction on the stage and landscaping is going full tilt.

As graduation day arrives, the decision to hold graduation in Killian Court—at the weather's mercy—rests with Hank Leonard and Langley C. Keyes, Jr., professor of urban studies and planning who is chairman of the Commencement Committee.

"Three times before when I got up at 4:00 a.m. to check the weather on graduation (or inauguration) day morning, it was pouring," he says with good humor and obvious dedication. But he has some technical support to bolster his decision: he enlists a meteorologist who he consults twice the day before and who begins to plot the weather in the wee hours of G-day. If the weatherman predicts clearing, the decision will be to go ahead. In fact, it has to be an extremely solid, gloomy forecast before a halt will be called, says Mr. Leonard.

This year, skies were clear. On June 1, plans swing into action:

6:00 a.m.: Personnel in the physical plant report to work.

6:30 a.m.: Diplomas, diploma racks and hoods are moved from the Registrar's Office, E19-341, to Killian Court and placed on tables on stage. The mahogany box containing the Mace plus the shepherd's crook is moved from a vault in the Registrar's Office to the Bush Room.

7:00 a.m.: Eight or more ushers report to Killian Court to place a program (6,850 of them) on each chair, to be completed before 8:00 a.m.

7:30 a.m.: The M.I.T. seal is moved to Killian Court and installed on the rostrum.

8:30 a.m.: Chairs in the graduates' section are ribboned off.

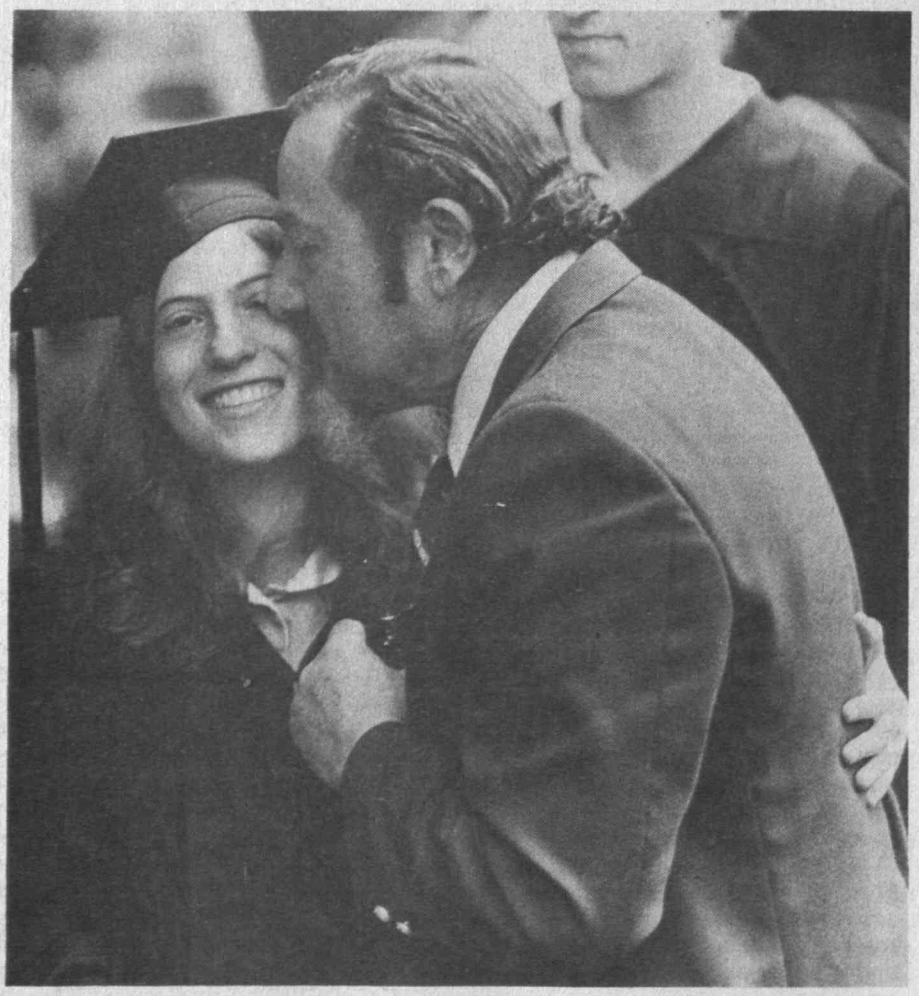
8:45 a.m.: Ticket entrances in Killian Court are opened for guests.

8:50 a.m.: A Thermos pitcher and six glasses are filled with water and placed inside the rostrum.

9:00 a.m.: Robing in the duPont Athletic Building and duPont Center Gym for students and faculty: now thousands of participants must be robed and lined up *in order*, diplomas stacked *exactly* in the same order, because President Gray will present each student with his or her diploma. A checker in the front lines will transmit by telephone any missing names to the diploma keeper—the errant diploma must be pulled from the stack or every person thereafter will be given the wrong one. Most colleges dare not tempt disaster hinged on such precision.

10:00 a.m.: The chapel bell rings three times with five second intervals. The procession begins. As the first stately lines of robes, hats and tassles slowly wind into view in Killian Court, a communicator radios to the front that their grand entrance is imminent. The announcement comes: "The procession is about to begin."

And the crowd is suddenly hushed.—*M.L.*



Paul E. Gray to the Graduates: The New Threats to Intellect, Freedom, and Opportunity

Following is the text of the address by President Paul E. Gray, '54, to the Class of 1981 at the Graduation Exercises on June 1:

Eight months ago I stood here to speak of my hopes and dreams for M.I.T.

I spoke of the need to reaffirm the values of science and technology and to rededicate them to the service of humanity.

I spoke of the quality of life we share and must seek for each other.

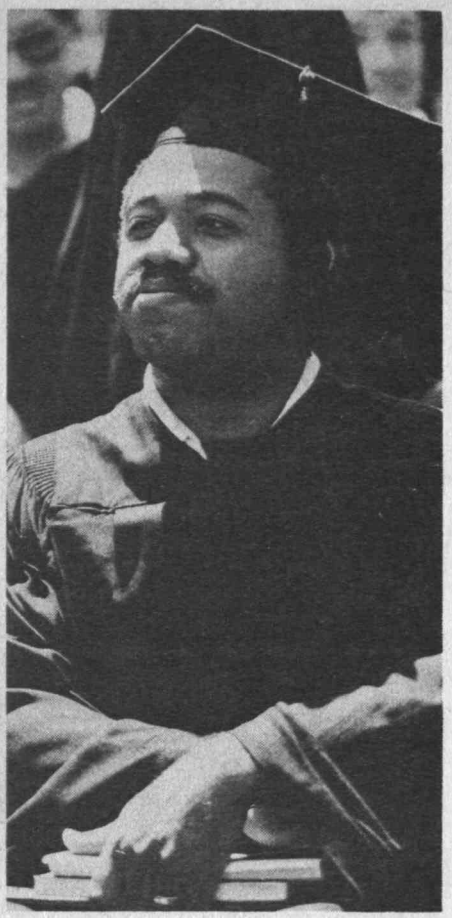
These hopes for M. I. T. are, I believe, in tune with the best values of American society and reflect the spirit which has made this nation great. Since that September day, however, there have been profound changes on the national scene—changes which may reshape many facets of our national life.

I would like to speak briefly this morning about some of these changes and how they affect the university and its role in society. Universities, like civilization itself, are most precious. It takes forever to create them and but a moment to lose them and everything they represent. It is because of this fragile quality that I speak about these matters today.

Preserving the American Academy

I speak first about the implications of some of the efforts by the government to balance the federal budget. To be sure, the need to revitalize our economy must be high on our national agenda. We have, as a nation, lived through more than a decade of extraordinary inflation—a condition which has had corrosive effects on most people and institutions, including the universities. The economic ills brought about by this climate—including unemployment, inadequate investment in the future, declining productivity, and diminished ability to compete in world markets—must be of grave concern to us all.

And it will not be possible to ameliorate these problems without the participation and commitment of us all—individuals and institutions throughout the society. This will require sacrifice on the part of many if we are to revive an economy plagued by years of stagnation and inflation. Surely there must be reduction



in federal spending. But I am troubled that some programs—such as many related to defense—are receiving little or no apparent scrutiny while others—having to do with education or social services, for example—are being proposed for major reductions. We need to become participants in, not simply recipients of, the decisions about the budget. Our fuller participation is necessary if the choices embedded in the national budget are to be informed by, and reflect understanding by, the people of this society.

It is in this spirit that I express my own views on the consequences of the proposed budget as they affect the university—as they affect principles at the heart of the American academy—particularly the research university. I am convinced that now is the time for clarity and strength of position regarding these principles. We must take care that our efforts to revitalize a troubled economy do not undermine those values.

What are some of the principles for which we who are in—and from—the university must speak? And what are some of the changes implicit in the evolving federal budget which may not bode well for these principles?

Endangering Our Access

First there is the long-held goal that access to higher education in this country is based on a person's merit and not on his or her ability to pay. As you here so well know—far more keenly than most—higher education in all its forms is expensive, and growing more so. And the prospects for federal financial aid programs look dim, if not bleak. Proposals to curtail sharply the Guaranteed Student Loan Program may have been made in response to perceived abuses of that program, but at least half of you here today must have seen such loans as indispensable keys to your future. The proposed cuts in this program, together with proposals to reduce funding for such federal scholarship programs as the Basic Education Opportunity Grants, are clear signals of a very different future with regard to access to higher education.

Eating Our Seed Corn

Second, there is the continuing need to regenerate the base of human resources and knowledge on which our national welfare depends. The United States is confronted by serious problems in assuring essential supplies of energy and raw materials, in increasing productivity, and in providing health care and environmental protection at reasonable costs. The future of our nation is dependent upon our success in attracting able young women and men to work on these national problems and in providing for them educational experience that will enable them to find

new and better solutions—solutions which fuse technical, political, economic, and ethical considerations.

But although the need for this kind of education and expertise has never been greater, we see a continuing decline in the number of U.S. citizens pursuing doctoral degrees in engineering and the physical sciences. Consequently, engineering schools already have difficulty filling faculty positions, and there are serious questions about the ability of the research universities to renew their faculties in the future. We are, in this respect, eating our seed corn, with the likely result, 10 years hence, that the number of engineers and scientists at all degree levels will fall short of national needs.

In light of these needs, the administration's proposal to eliminate the fellowship program of the National Science Foundation and to virtually eliminate the NSF's science education programs for minorities and women are signals of precisely the wrong kind, coming as they do at a time when many able students are turning away from graduate study in the sciences and engineering.

Eroding the Foundation of Research

Third, we need to preserve the unique dynamics of the U. S. research universities, which have contributed so much to the public welfare and the national purpose. In these research universities the U. S. has a model for achieving scholarly accomplishment and education which is unmatched in the world. By engaging graduate students—and at M.I.T. many undergraduates as well—as partners in research, and by translating the newest findings into classroom teaching, research universities couple scholarly progress to an endless stream of able, curious, and committed young people, rich in ideas and energy. In so doing, they create a constantly renewed base for advances in knowledge and innovative application of research findings. There is no generation gap between the research endeavor and the classroom.

But the abandonment of long-delayed, desperately needed initiatives for equipment and facilities renewal, as well as other possible cuts in funding for university-based research in the sciences and engineering—to say nothing of the social sciences, the humanities, and the arts—could quickly erode the foundation and the momentum of this country's research enterprise. Since the late 1960's there has been scant attention paid to the capital base of the research universities, particularly with reference to facilities and instrumentation, and this neglect seems likely to continue. Its effects, like those of dry rot, may remain hidden for a few more years, but they are palpable and they are real.

The Commitment to Equal Riches

Beyond the implications of these budget proposals for the universities, there are other signals of changing times and changing sentiment in this country—some of which seem to be reflected in a changing posture with regard to the regulatory mechanisms of the government—which bode ill for education and research and institutions devoted to them. The president has called for the "deregulation" of our society—a call which responds to popular sentiment about an overgrown federal bureaucracy. But this call appears to be directed toward some programs and not to others. We see, on the one hand, initiatives to review and perhaps reduce regulations pertaining to civil rights. On the other hand, we see an apparent expansion of government regulation into the realm of academic inquiry.

And while there is a clear need for a review of regulatory mechanisms which have grown with astonishing vigor during the past two decades, we must take care not to confuse regulatory mechanisms with the underlying principles they were meant to serve.

Consider, for example, the goal of achieving a society in which all individuals can reach their highest potential—in education and employment—regardless of race, age, sex, or national origin. Many of the relevant regulations, while

intended to further that goal, have been largely indifferent to the special features of colleges and universities, and some revisions of regulations and practices are in order. But it is of cardinal importance that revision of these regulations not be—or be seen as—a turning away from the underlying goal of equality of opportunity. There is a considerable risk that review of specific rules will give permission to those who are fearful of change to act on those fears—to act in ways which diminish us all. At the Institute we will adjust to changing regulations, but we will not change our commitment to equal opportunity and to developing an environment which encourages diversity, opportunity, and growth for all people who study or work here.

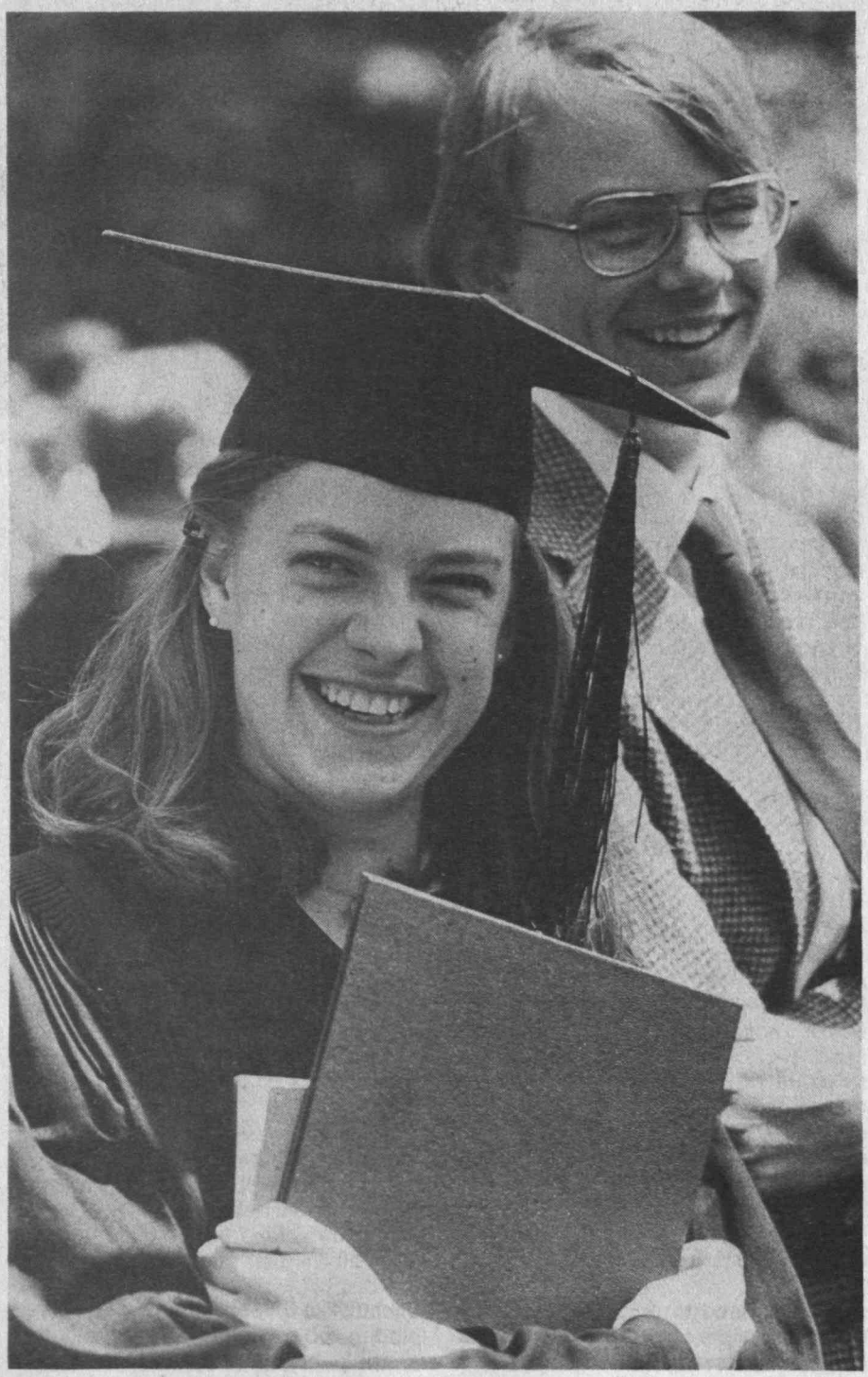
Controlling Technological Commerce

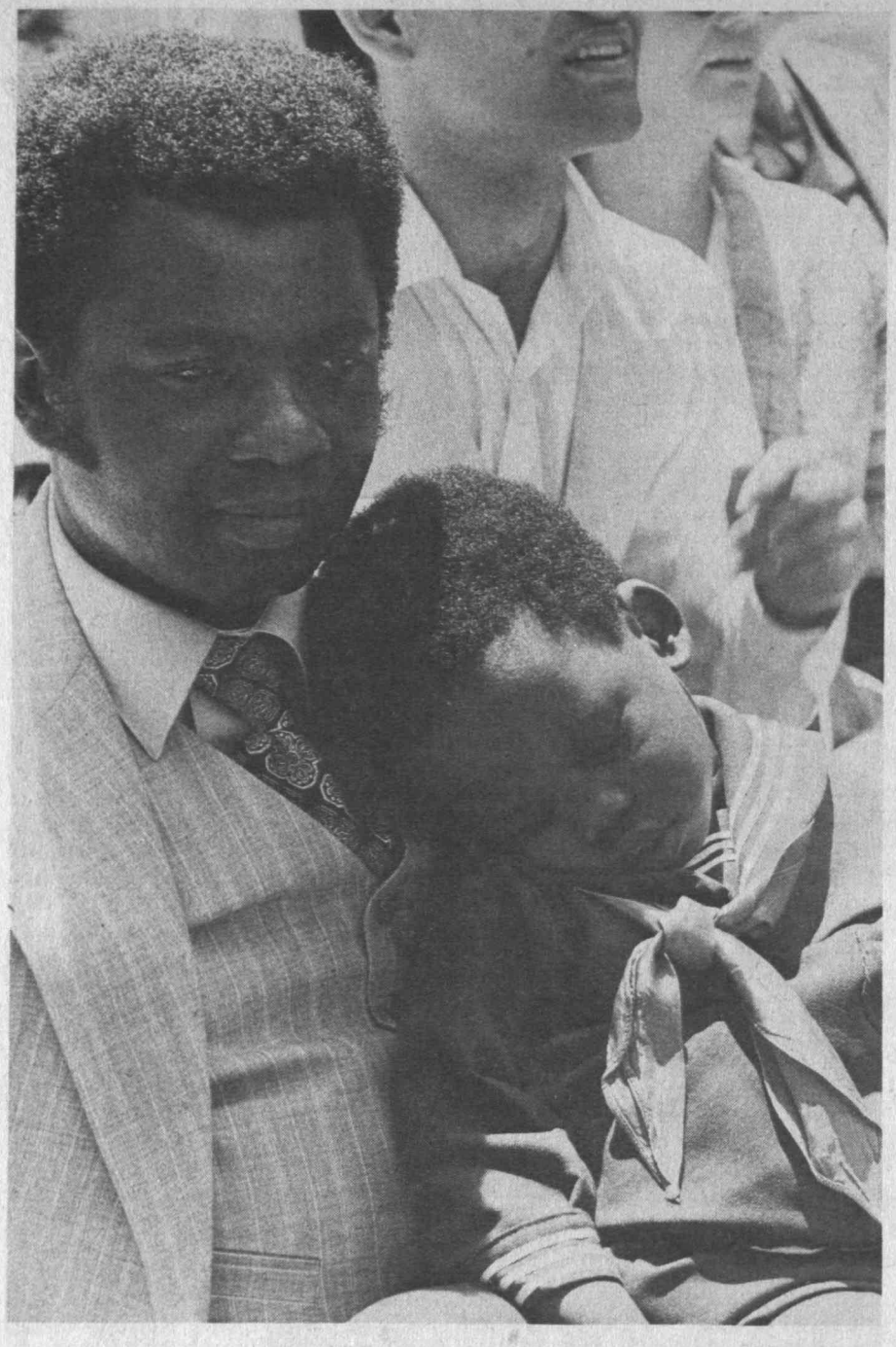
While we are experiencing a review and apparent weakening of federal regulations in some areas, however, we see an ill-defined expansion of regulatory activity in other areas. Let me cite just one example.

Under a number of statutes, the United States has, for nearly three decades, controlled exports which might have an adverse effect on the nation's military security, foreign policy, or domestic economy. Throughout this period the universities have made significant contributions to this nation's scientific and technological leadership, and thereby to its industrial and economic strength. Both the government and the universities have, in differing fashion, pursued similar goals—and, until recently, without conflict. Now, however, there is an increasing concern in government agencies about the export from the U.S. of technologies which are deemed to have critical military or commercial importance, and efforts are being made to implement export control statutes through regulations which restrict the dissemination of unclassified research results which emanate from the nation's universities.

There might be no quarrel with the proposed regulations if they were confined to specialized technical information of clear and specific military applicability. The regulations, however, are being applied in such fundamental research areas as microelectronics and cryptography, and they assume that basic research can be clearly differentiatied and separated from applied research. Such neat distinctions are difficult or impossible to make, however, in most research environments, particularly in fields where progress in applications depends on fundamental advances in design methodology and materials science, as is the case with microelectronics.

Opposite: *Commencement Day had more than a little special meaning for Michael Ray, '81: he has the double handicap of being unable to hear or speak. Mr. Ray was helped through his mechanical engineering studies by Francis Demiany (left) and a number of other interpreters who used hand signs for communication. Mr. Ray's father, Professor Daniel B. Ray, a 22-year veteran of the faculty in the Mathematics Department, had died suddenly shortly before Commencement. (Photo: Calvin Campbell)*





Furthermore, these regulations, if strictly enforced, would define the "export" of technology in ways that would circumscribe the research process and undermine the foundation of the university by impeding our ability to offer educational programs which reflect the forefront of rapidly changing fields. In the broad scientific and technical areas defined by the regulations, faculty could not conduct lectures with foreign students present; they could not exchange information with foreign visitors; they could not present papers or participate in discussions at conferences where foreign nationals were present; they could not publish research findings in the open literature. Nor could universities, in effect, admit or employ foreign nationals to study or work in those areas.

M.I.T. is an international institution—reflecting and supporting the fact that curiosity, inquiry, creativity and knowledge have no nationality. It is, like all universities, a fragile institution, based on scholarship, open inquiry, and free communication. The best guarantee for scientific progress—indeed for all intellectual growth and excitement—rests with the affirmation of the principles of free and open inquiry. Those who would circumscribe the free exchange of ideas among scientists and scholars in the name of protecting this country's technological lead would, on the contrary, inflict severe damage on the very system responsible for creating that lead.

The Most Important Challenges

I have been speaking this morning about changes—changes on the national scene which presage a troubled climate for the universities and for the larger society which you are about to enter.

The poet of Ecclesiastes spoke of changing times, saying:

"To everything there is a season, and a time for every purpose under the heaven . . .

". . . A time to get, and a time lose; a time to keep, and a time to cast away."

Today, we are in a time to keep—a time not to yield—those values which are the foundation of the university and the wellspring of opportunity and justice for all people in our society.

The challenge before you, the graduates of 1981, is whether you are willing to take responsibility for the world you are about to enter.

Certainly we challenged you while you were here:

☐ We challenged you to develop discipline and intellectual power.

☐ We challenged you to reach beyond what you thought your capabilities to be.

☐ We challenged you to combine your growing scientific and technical knowledge with cultural and social perspective.

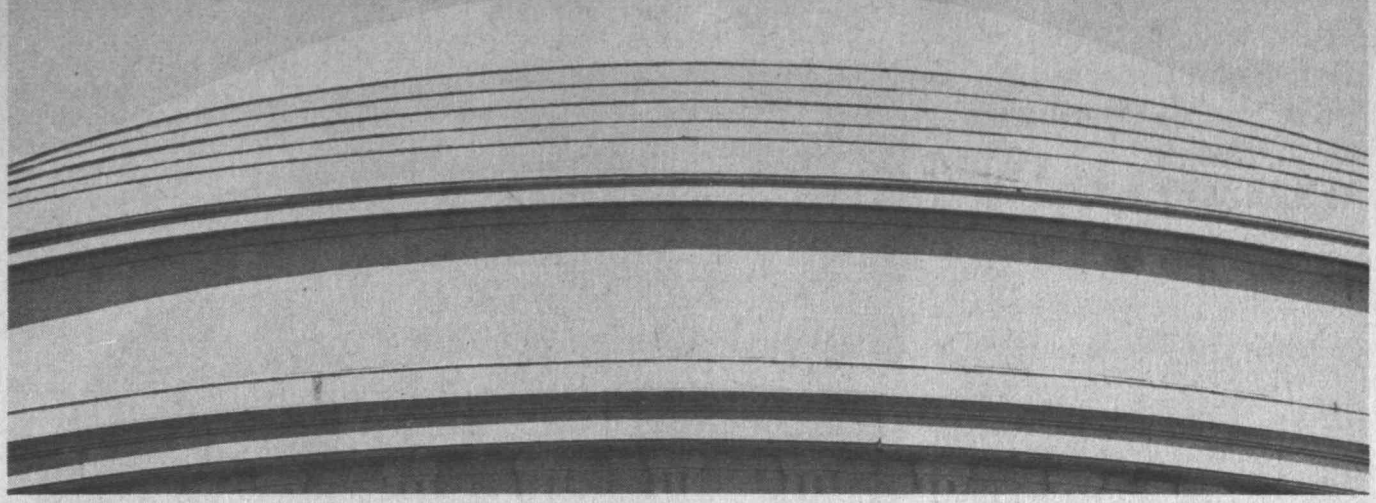
So you leave here having met and mastered many challenges. But you have not yet met the most important challenges:

☐ Can you—will you—strive to create and defend the principles of open inquiry and open communication—wherever you are, whatever you do?

☐ Can you—will you—put your education to work for a better society—wherever you are, whatever you do?

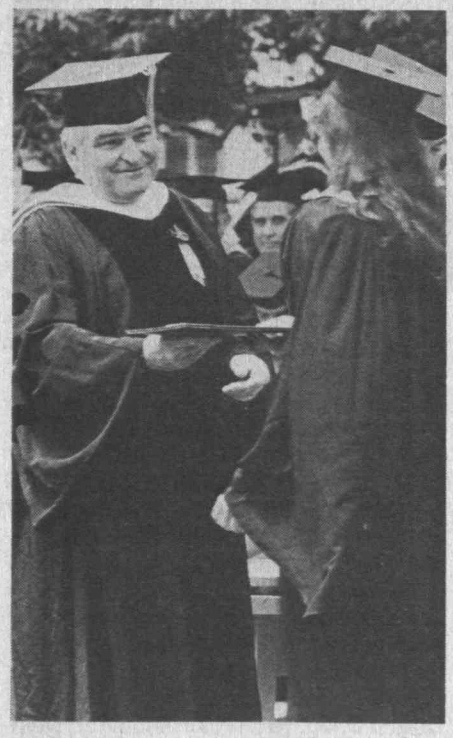
☐ Can you—will you—take direct care and responsibilty for the welfare of other human beings—wherever you are, whatever you do?

I believe you can. I believe you will. It is time. Good luck and Godspeed.



Education: An Investment?

by Steve Solnick, '81



I was discussing M.I.T.'s graduating class the other day with someone who graduated from Harvard in 1970. We were both amused to discover that these two classes, only eleven years apart, were so very different.

In 1970, male college students wanted nothing more than to remain in college. To leave college was to be drafted, and that meant Vietnam. In 1981, M.I.T. students try, if at all possible, to finish their major quickly. Every term at M.I.T. beyond that needed to graduate costs an extra six or seven thousand dollars in expenses, not to mention the wages foregone.

Harvard's graduating class of 1970 gave little thought to money-making careers in their choice of college major; in fact it was "a little dirty" to choose a major on the basis of what the job opportunities would be upon graduation. It was far more acceptable to pick a major that related to public service or intellectual passion. In 1981, or course, graduates are attracted to electrical and chemical engineering by the lucrative job market. In fact, M.I.T. often justifies its steep tuition by comparing it to the median starting salary of its graduates.

In 1970, careers were often things to be considered after the four undergraduate years were over. Undergraduate education provided a broad background for future endeavors. In 1981, the M.I.T. undergraduate education can easily be viewed as career training.

In 1970, at Harvard anyway, the university "took pride in changing students' minds about their majors." At M.I.T., in contrast, students are asked to declare their majors after their freshman year and very few departmental programs can be completed in four years without at least being started by the sophomore year. Students who use freshman year to take Institute requirements and sophomore year to explore interests and "shop" for a major may find themselves in need of an extra term to meet the requirements for some degrees. Nowadays, that is a very expensive proposition.

Maybe a summary way of looking at it is to say that, in 1981, at M.I.T., undergraduate education as an *investment* is a dominant theme. As I see it, the key to the ongoing discussions about reducing the pace of life at M.I.T. is to check the concept of M.I.T.-as-investment and reassert the concept of M.I.T.-as-education.

Looking back on the experience now, merely hours before snatching the sheepskin and hopping off the treadmill, what I see is not four years of investment in my future career but rather four years of broad education. I've often been accused of being overly harsh and pessimistic about this Institution. If so, this is inadvertent.

What I see in M.I.T. as I prepare to leave it is not, as some people think, a cruel, ivory-tower, academic sweatshop. I see instead a university populated with brilliant people and an almost unlimited potential for learning, enjoyment, and experience. If anything has frustrated me in my time here, it is not that these opportunities are totally wasted, because many take advantage of them. Instead, it is frustrating to see that M.I.T. does not make the *most* of its potential, that through its pace, its values, and its philosophies M.I.T. all too often ignores Twain's warning to "not let schooling get in the way of your education."

It is a fine line for a school and its students to follow. Maybe it is an impossible one in technical courses. But as I walked down a very different kind of line at graduation, I decided M.I.T. was taking another step in its decades-old search for the "right" balance between training and education. It was getting rid of some pests, but was also adding some new alumni to mold its values and to carry the torch.

I, for one, will try to carry it high.

Steven Solnick, '81, editor-in-chief of Volume 100 (1980-81) of The Tech, *holds a Marshall Scholarship for study in England this fall.*

High-Tech Diplomas; Most M.I.T. Graduates Go To Work At $25,000 a Year

by John Powers
Globe *Staff*

The following is reprinted courtesy of The Boston Globe

The Toolbox, as the student center library is known by some, is empty now. No need to powertool, which is M.I.T.-ese for cramming. Thermo, partial molar quantities and logarithmic functions upon demand are history. Exams at Tech were finished Thursday. Commencement is still a week off.

So there is time for "hacking." The Class of 1981 will go on a harbor cruise and have brunch together this week. And then its Living Groups—the Bombers, Chocolate City, Lambchops, Players. Smokers, Squanches, Vigilantes, Virjins and other randoms—will leave their dorms and frats and go off, equisitely prepared, into the arms of An Wang, Boeing and Chevron. But not without a great whoosh of relief. That much is Intuitively Obvious, as they say around the Dome.

"I haven't seen people saying, Gawd, this is the end of all this fun," says Steve Solnick, '81, former editor of *The Tech*, the campus newspaper. "It's just not there at all. It's more a feeling of 'I survived.'"

Most of M.I.T.'s seniors (85 percent) were public high school math-and-science stars who arrived at Tech's functional wedge of Cambridge planning to be engineers of some description—electrical, mechanical, chemical. After n quantity of complex technical courses and a dabble of humanities, most of them are emerging precisely that way.

The majority will immediately command salaries (roughly $25,000 to start) that will both delight and appall their parents. "I told my father what I was getting," says class president Lynn Radlauer, who had 11 job offers. "And he said, you're not worth that much."

But they are. American technology—its high-tech firms, oil companies, defense contractors—is clamoring for the kind of energetic bachelor of science that M.I.T. has been guaranteeing for more than a century. More than 400 firms knocked on director Bob Weatherall's door this year at the Office of Career Planning and Placement and lined his walls with thick looseleaf binders explaining themselves.

The M.I.T. degree is unquestioned currency anywhere in the world, which is why women have flocked to the Dome in increasing numbers and make up a quarter of the senior class. Male or female, you can't fake Thermo. Make it through the Institute and no eyebrows are raised. "People take you seriously," says Radlauer.

Sometimes they even take you as a savior. Tech's seniors realize that the firm that hires them already has a labful of technical glitches standing between a product and the marketplace. They're being paid for answers. "I turned down my most lucrative offer," says Radlauer. "Because their idea was: We'll put you in a corner, give you a computer, and three months later . . ."

Unlike many of their liberally educated Ivy counterparts. Tech's seniors are finished products, ready to step into any technical corporation anywhere and begin solving problems.

"Buy The Ticket, Take The Ride"

They did not come to M.I.T. to find themselves. That is done Up the Creek. At Harvard, it is something of an achievement to undergo a personal metamorphosis during one's four years. Around Technology Square, it is seen as an unsettling sign of uncertainty. To undergraduates who gripe that the place is less a university than a trade school, the answer is: "You knew what M.I.T. was. Buy the ticket, take the ride."

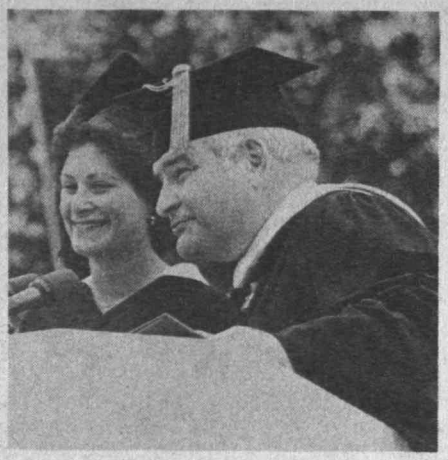
Much of the Class of 1981 fought that idea. They joined athletic teams and drama groups and the campus newspaper, still got their problems sets in, and are leaving with a sense of personal victory. "I feel that I did it my way and it still came out all right," says Julia Neuringer, who wound up as something of a field hockey immortal after four years but still learned her physics.

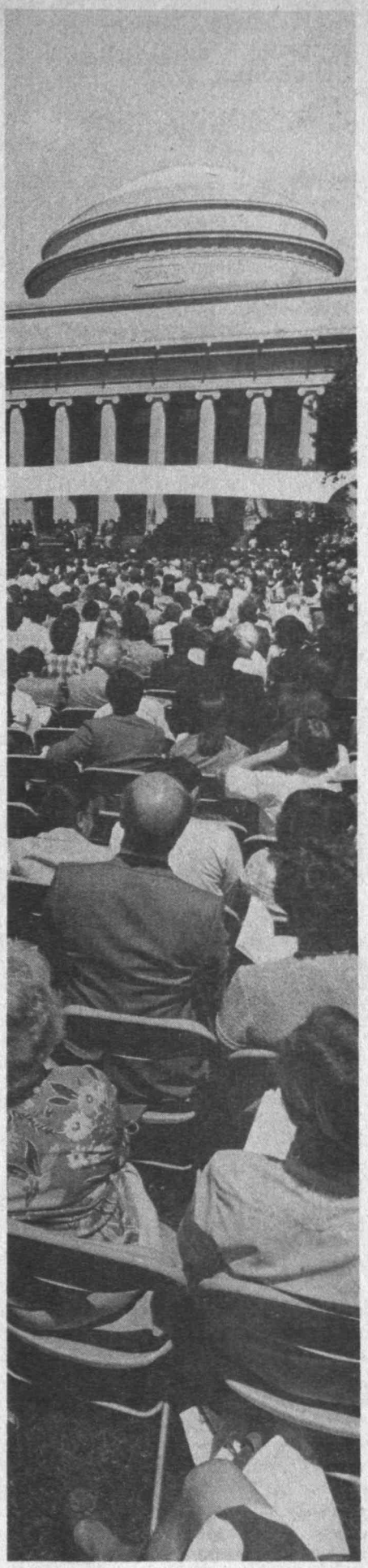
Radlauer made it a crusade to get the class involved as a group, to push Homecoming and all-campus events, to develop a less hermetic atmosphere. Solnick ran the paper and acted in the Drama Shop. Rebecca Henderson went on tour with the Shakespearean ensemble as the female lead in "A Comedy of Errors." But it meant fighting the pace and the image.

Because the Tech stereotype endures—the flannel-shirted, desert-booted male mechanical engineer with his head titled 10 degrees, a T-square hanging from his belt, a row of pens in his chest pocket, and a vacant glaze in his eyes. The Tool. The Beaver. The Gnurd.

Henderson, who came out of London's St. Paul's School for Girls to major in mechanical engineering, was warned about the image by English friends. "I heard, don't go there, you'll come away strange and twisted," she says. "But I also heard, it's the best engineering school in the world, great professors."

Right: *From Lynn Radlauer, president of the Class of 1981, to Paul E. Gray, '54, president of M.I.T.: a gift of $2,300 and a pledge of over $12,500 from the class for the Alumni Fund before 1986. The 50-year class of 1931 later announced that it would match 1981's $2,300, the total making possible a barbeque area for the courtyard of the new Athletic Center. (Photo: Calvin Campbell)*





So she came to M.I.T. and became a Shakespearean actress on the side. It was part of a battle that many of her classmates indulged in for four years to break down the image, or at least to broaden it. They believed that the work didn't have to be obsessive, that it was possible to drink a beer at football games, to go to rock concerts, to play field hockey and still be a serious student.

The administration encourages that kind of diversity and has made a point of turning down a number of hopeless if brilliant recluses with multiple 800s. They fret about the pace, urge undergraduates to take normal loads, assure them that it is no disgrace to be in the bottom half of the class, no stigma to spend a soothing hour with a university counselor. But few students listen.

"Seventy percent of the pressure here is self-generated," Henderson says, "and most of the people don't know how to study. So they spend hours staring at those damned books or sit around talking about how much work they have to do. There's pass-fail freshman year, but most of the freshmen I live with are going crazy. I say, relax, all you have to do is pass. But they say, no, no."

The Eternal Question

The administration worries that the image is still based in reality. In his inaugural last fall, President Paul Gray wondered about The Pace (always in capitals). Was the Institute putting its undergradutes under too much pressure?

The seniors smile at each other when the issue comes up—*ah, the eternal question.* The pressure, they say, is endemic because of the complexity of the work and the nature of the undergraduate and neither is likely to change.

More than half of the 1089 seniors were in the top tenth of their high school class. They are instinctively competitive and most arrived pretracked towards some kind of engineering. "A year before I came to M.I.T. I'd already decided exactly what I was going to major in and why," says Bert Vermeulen, "and that I wanted to go to business school afterwards."

Given that kind of self-predestination, the system take over and adds its own kind of anxiety. "It's not, 'Will I get my degree?'" says Henderson. "It's, 'I have four problems sets that have to be done by nine tomorrow.' It's the day-to-day amount of work that has to be done and in."

Moreover, the average Tech undergraduate believes that his peers are doing it easier and better. He is convinced that the rest of his Living Group has more raw intelligence, more stamina, more sheer capacity.

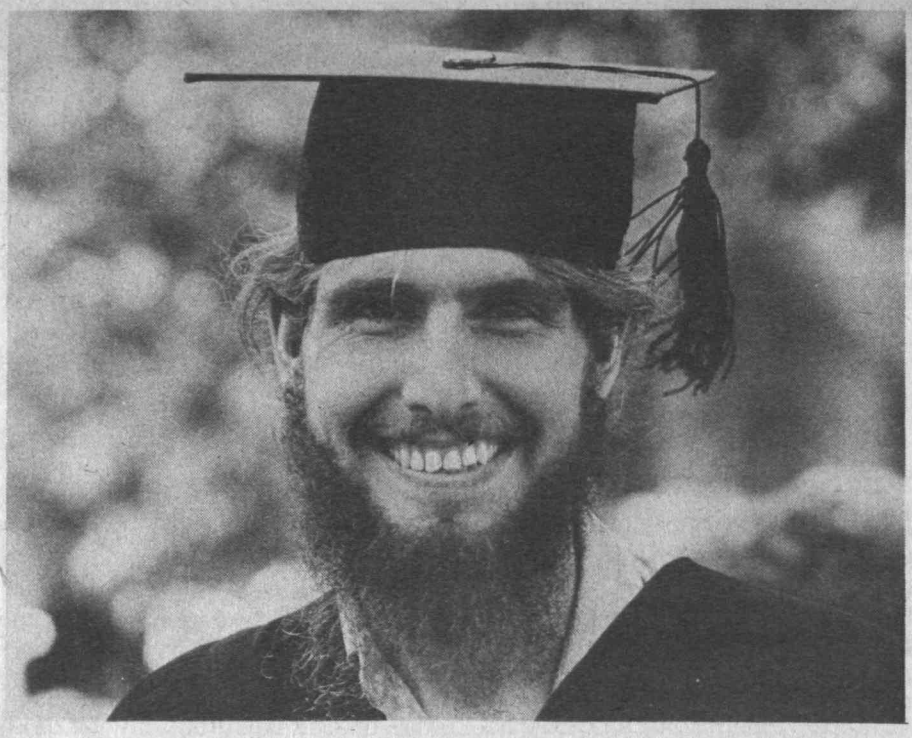
Yes, Money Is Important

Inflation, the sheer cost of the burden, does the rest. Since tuition has been rising sharply and M.I.T. charges not by the course but by the year, many of Henderson's classmates deliberately overloaded. "There's a rush to get as much education as quickly as you can," admits Vermeulen, who got both his B.S. and M.S. in mechanical engineering in four years.

Thus trapped by the economy, the Class of 1981 is determined to wring a delayed payoff from it. Money has been an obsession with them because inflation and the job squeeze made it so. "There's the feeling that if you're going to spend $10,000 a year you want to emerge exhausted," says Solnick, "What drives a lot of people through here is the money they're going to make."

If aero-astro (aeronautics and astronautics, a fifties and sixties favorite) has slipped dramatically in popularity, it is not because of any moral aversion to the defense industry. It's pure economics. "There's a residual feeling that it's a boom-and-bust industry," Weatherall says.

The Class of 1981 is intensely interested in money and makes no apologies for it. They've ground their brains to powder since 1977 and are convinced



they've earned their place in the meritocracy. The kinds of moral dilemmas that troubled the Class of 1970 (How can I make napalm for Dow?) seem alien to them. "It just seems to be so different here now," says Neuringer.

Tech's seniors are aware of El Salvador and Poland and the American ghetto. They were disturbed by the resurrection of draft registration. But they've also seen what America has done to the well-rounded, vaguely-prepared humanities majors of the past decade and are determined to protect themselves.

So electrical and chemical engineering (oil companies, you know) are enormous magnets to them—a quarter of the class majored in EE, and 40 percent of them have taken jobs with Massachusetts high-tech firms that they feel offer them immediate creative responsibility and superb money.

Yet salaries are not the primary concern for Tech's seniors. The money is going to be good anywhere. What they want is more of the mind-stretching creative challenges they've grown used to.

"I couldn't see myself in a large corporation on a floor with 300 other engineers and an in-basket and an out-basket," says Vermeulen, who is a model for the entrepreneurial engineer that the Class of 1981 is turning out, the double-barreled technician/manager for the nineties.

Vermeulen came here from Colorado, used his five-week winter break to visit Europe as a freshman, and has not taken a vacation since. Summers were spent developing programs and doing analyses for General Motors and Parker Hannifin. He carried his double S.B./S.M. course load and did consulting work between semesters. He finished his thesis on a Friday, began work the following Monday developing electrical connectors for a Route-128 firm, and will go to Stanford Business School two years from now.

Henderson and Radlauer will both wind up at B School, along with as many as half of their classmates. Neuringer is wait-listed at several medical schools; even so, she can always get a job as a physicist. Others will take a different route but still scientifically-related.

"I've always dreamed about going to a school where I could do a lot of reading, then sit back to synthesize my thoughts about it," says Solnick, who envied his Harvard counterparts who could wander off for three weeks and still catch up on their political science during reading period. So he'll go to Oxford on a Marshall scholarship and read politics, philosophy and economics.

He wouldn't want to send his child to M.I.T., Solnick wrote in the *Technology Review*. There simply wasn't enough "undergraduate life" to the place. His is one view, probably the minority view. Despite the social semirevival that the Class of 1981 helped spearhead, the majority view is more likely Vermeulen's.

"You can't expect it to be Harvard," he concludes, "because it never said it was."

Sciences in the Eighteenth Century: "Cherished Objects of Gentle Folk"

"Kant and the Ideals of the Enlightenment," "Constructing the Female Self," "The Image of the Noble Savage" are not typical topics for a conference held at M.I.T. But from October 9 through 11, M.I.T.'s first humanities conference brings discussions of these topics plus a wide range of others centering in eighteenth century history, science and literature. Ruth Perry, professor of literature in the Department of Humanities, is organizing the conference, which is also the annual meeting of the Northeastern American Society for Eighteenth Century Studies.

Prized for Beauty and Function

The first-time-ever conference will be complimented by an exhibit of eighteenth century scientific instruments at M.I.T.'s Compton Gallery. Funded by a $25,000 grant from the National Endowment for the Humanities, the exhibit will be on display August 28 through October 30.

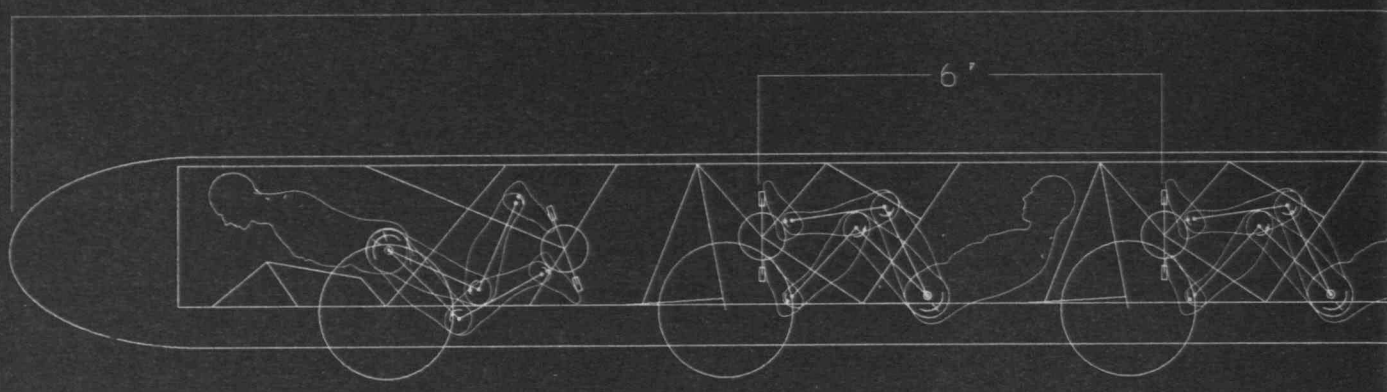
The exhibit focuses on an imaginary eighteenth-century family whose members were involved in trading, farming and scientific research. "The family depicted has a collection of scientific instruments in part because they are so beautiful. Made one at a time, they were cherished objects of gentle folk, prized by owners for both beauty and function," says Professor Perry.

A glimpse at the imagined family and their interests:

James Clark emigrated from Bristol to Massachusetts in e made his fortune as a merchant and settled on a farm north of Boston. From instruments found on merchant ships (sextants, compasses, and polished brass telescopes), the exhibit moves to Clark's son William, whose studies at Harvard gave him access to the latest carved wooden microscopes. As the three generations of family members' experiences widen, so does the variety of instruments they use and when possible, collect. On exhibit will be several orreries (mechanical models of the universe), an electrostatic machine, various kinds of hydraulic mechanisms, a surveyors level, pedometer, planispheres, pocket globes, a model of an eye, a 1724 pocket watch, and other marvels of the day.

The scientific instruments are on loan from Harvard, the Smithsonian

Many scientific instruments of the eighteenth century were prized by their fortunate owners as much for the quality of their craftsmanship as for their utility, and they continue to be prized for the same reason today. A rich collection of such instruments, arranged by the M.I.T. Museum, will be in the Compton Gallery beginning on August 28 to compliment the Boston meeting of the Northeastern American Society for Eighteenth Century Studies. Included will be an equatorial mounting, such as that shown above, containing clockwork to keep the astronomer's telescope aligned with a star despite the earth's rotation.



Group Velocity: The World Human-Powered Speed Record Will Fall in September

"Join us, by September, 1981, we'll set a new world speed record for human-powered vehicles."

There's nothing modest about this bunch: "Group Velocity will bring to bear the talents and resources uniquely available at M.I.T. to solve a problem in advanced technology."

The quotations are from announcements of Group Velocity seeking student participants in the first case and $34,500 in the second case for a summer-long project to design, build, and race a vehicle powered by a team of six riders to at least 70 miles per hour; the current world record is 62.93 mph.

Project Velocity is the brainchild of Bruno Mombrinie, '82, Stephen Young, and J. James Papadopoulos, '79, conceived with the help of Professors Woodie C. Flowers, Ph.D. '73, and David Gordon Wilson of the Department of Mechanical Engineering. Professor Flowers is famous for his innovative design problems given to mechanical engineering students every fall, and Professor Wilson for the recumbent bicycle on which he commutes to work every day.

Project Velocity's vehicle will be a

Musuem in Washington D.C., and several other institutions. The exhibit has been organized by Dr. Perry with the assistance of Harriet Ritvo, assistant professor of writing, Kenneth R. Manning, associate professor of the history of science, and consultants from other universities. Warren Seamans, director of the M.I.T. Museum, is project director, and Joan Luria, curator of exhibits at the M.I.T. museum, has designed the exhibit.

Science, Myth, and Knowledge

More than 200 scholars—many of them leading figures in the field of science history—will participate in the conference, titled "Science, Myth, and Knowledge." In addition to the 36 discussion panels, conference activities will include an authetic eighteenth century banquet for participants, complete with roving musicians playing authentic Baroque music.

The menu: sherry and white wine with crocks of Hannah Glasse's potted cheese, "soop maigre" (a thick soup made chiefly with lettuce, celery, bread and egg yolk), roast duck, potato pudding, tansy pudding (spinach custard), ornamental salad (edible) centerpiece, and John Farley's French flummery. A gallant red and a fair white wine will be served with the meal, and a robust Madiera with the dessert.

Also on the schedule: exhibitions of drawings at Harvard's Fogg Museum and of rare eighteenth-century books of science at the Houghton Library (Harvard) and a program of eighteenth-century music played on instruments of the period.—*M.L.*

AOC: September 25-26

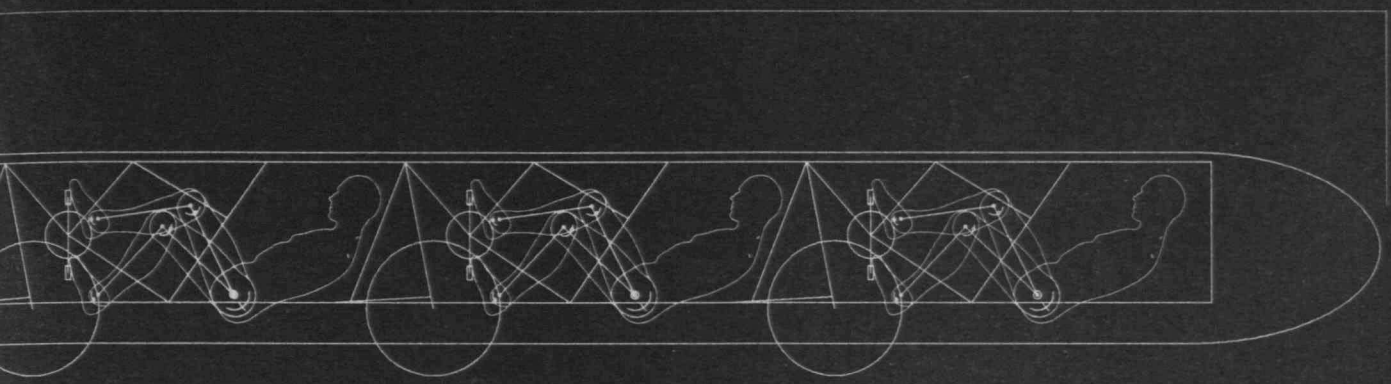
Alumni officers—leaders of alumni clubs, classes, and the Alumni Fund; members of the Educational Council and the Alumni Advisory Council; and members of the Board of Directors of the Alumni Association and its many committees—will gather in Cambridge on September 25-26 for the 1981 Alumni Officers Conference to begin planning for a new year of world-wide efforts in support of M.I.T.

Workshops on various alumni service programs on Friday afternoon (September 25) will be followed that evening by a dinner with President Paul E. Gray, '54, as principal speaker. Saturday's program includes formal presentations by principal officers of the Alumni Association; the Robert H. Richards Lecture by James B. Reswick, '43, director of rehabilitation engineering at Rancho Los Amigos Hospital, Downey, Calif.; the annual awards luncheon; and afternoon sessions on biomedical research at the Institute. For further information: Joseph J. Martori, Associate Secretary of the Alumni Association, Room 10-110.

An Old Hand Becomes New Dean at the Sloan School

Professor Abraham J. Siegel, who has served as acting dean since William F. Pounds resigned as dean of the Sloan

Professor Abraham J. Siegel, who served as acting dean in 1980-81, has been named to succeed William F. Pounds as dean of the Sloan School of Management.



recumbent design, to reduce as much as possible the frontal area and hence the wind resistance of its aerodynamic body. The nine-wheel streamliner will be approximately 42 feet long and will weigh "no more than" 250 pounds, according to Howard J. Rosenberg, graduate student. Each rider, except the prone 'captain,' cranks with both feet and arms. The many-wheel design is known to present problems with steering and handling. But the power-to-weight ratio of the design (yet to be precisely measured) is compelling: like the human-powered aircraft *Chrysalis* on which Mr. Mombrinie worked two years ago, extra weight is an anathema to human-powered vehicles.

Construction is set for July, testing, training, and qualifying the design for August, and the 70-mph attempt for the international competition in Brighton, England, on September 5. Meanwhile, prospective riders are to be evaluated on an "adjustable recumbent simulator and dynamometer." The best (and lightest) will comprise fast company indeed.

As this issue of the Review *went to press, a team of M.I.T. students was completing plans (as drawn by their computer, above) for a many-wheeled vehicle with which to challenge the world human-powered speed record in September. In this design, the lead pedaler, recumbent forward, would steer by following the painted centerline of the test course.*

School of Management a year ago, has been named the school's new dean.

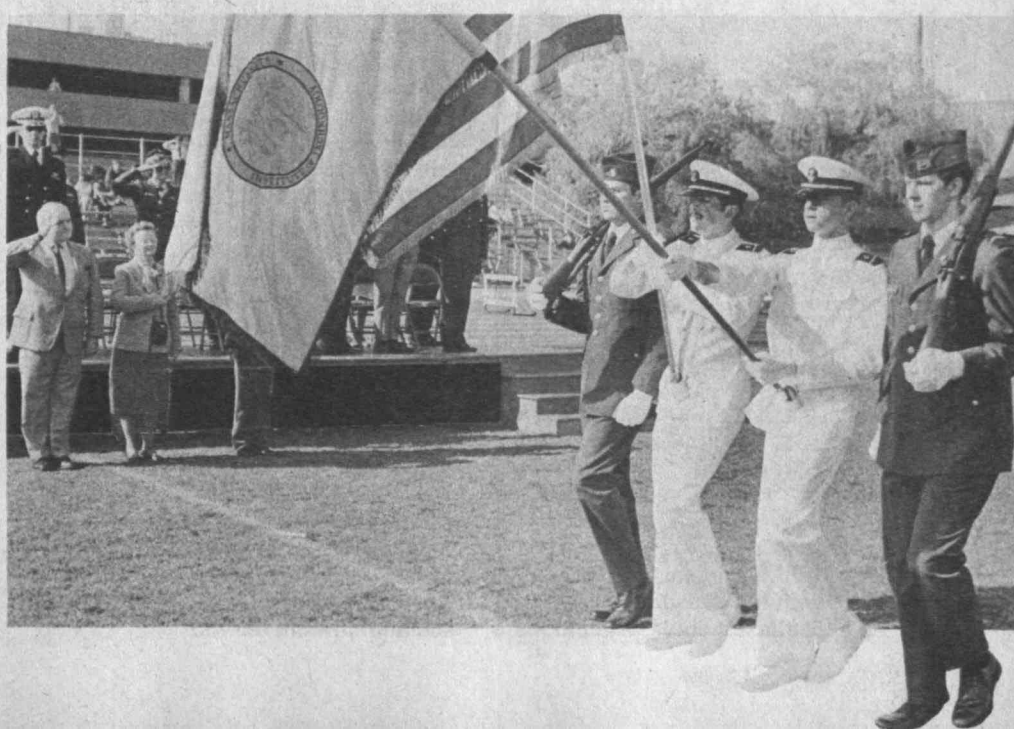
In reporting the choice, President Paul E. Gray, '54, told the school's faculty that there had been an extensive search, including consideration of outside candidates. But Professor Siegel's qualifications in administration (he was associate dean of the school from 1967 to 1980) and industrial relations—the field in which he has studied and taught at M.I.T. since 1954—won him the post.

Professor Siegel will continue to hold dual appointments in the field of industrial relations in the Sloan School and in the Department of Economics. He's widely known for research on labor-management relations and for consulting for labor unions, industrial organizations, and government; and he's also served as fact-finder, mediator, and arbitrator in labor-managment disputes.

Professor Siegal began his academic career as an instructor in economics at the City College of New York, where he received his B.A. degree (1943). From 1952 to 1954 he was research economist at the Institute of Industrial Relations at the University of California, Berkeley, from which he received his Ph.D. degree in 1961. Since coming to M.I.T. he has held visiting assignments at Harvard, Brandeis, and the International Institute for Labour Studies, Geneva, Switzerland.

Commissions to 63 New Officers

Over 540 students—including some from Harvard, Tufts, and Wellesley—were registered in the M.I.T. Reserve Officer Training Corps in 1980-81, and 63 of those received commissions in the Army, Navy, or Air Force at the annual ceremonies on May 31. Fifty of the new officers were from M.I.T., seven from Tufts, and one from Wellesley; five Harvard seniors were the first to complete four years of ROTC at M.I.T. under a new cross-registration arrangement. The Commissioning Exercises were a family affair: 14 of the new officers were commissioned by their fathers who are military officers, one was commissioned by a prospective father-in-law, and one received her commission from her husband of one week, Lieutenant John C. Barr, '78. The photograph shows President and Mrs. Paul E. Gray ('54) reviewing the M.I.T. cadets.



A Big Year in Placement; but Do They Ask the Right Questions?

"It's a wonderful year for students graduating," says Robert K. Weatherall, director of career placement and planning.

The Placement Office has been busy—a classic understatement. Indeed, more than 400 companies came looking—many twice, many more than twice—at peak time during February and March, a great swarm jockeying for place.

Salaries are up again. One student graduating with a bachelor's degree in biochemical engineering turned down a $32,000 offer to take a $36,000 job. (Yet—despite all the talk about the new field of biotechnology—the real demand for students in that field seems to Mr. Weatherall about as limited as the supply.)

Company recruiters are asking how to improve their appeal, to present themselves better. Each wants its brochure to be best, its emissaries most convincing. For example, most send M.I.T. people to catch M.I.T. people—Hewlett-Packard, Bell Labs, Proctor and Gamble, Exxon, Watkins Johnson—says Mr. Weatherall. "Sometimes I think it's the strongest alumni relationship we have."

Mr. Weatherall welcomes the information about jobs and careers which the alumni bring back. "Students need someone who will talk about the working world with knowledge and without prejudice," he writes in a lucid critique of the job counseling profession in the June issue of the *Journal of College Placement*.

"No one I know chose their career because they conducted the sort of self-assessment the popular manuals recommend. What was crucial was not self-knowledge but knowledge of the opportunity.

"The key question we should be asking the career seeker is what is it that really interests him, what is it that he would most like to do. Perhaps the students I see are not typical, but it is rare that a student does not have some answer to this question.

"The problem is that there isn't a bridge between (one's values and one's skills.) However carefully one may have assessed one's inner bias, in the end it is what one knows and thinks about a particular career that determines where one runs down the bank and strikes across the river. It is truer to say that one is 'drawn' to a career than that one chooses it. It is what a career appears to offer, not where one finds oneself standing, that matters."

Relieving Pressure in the President's Office

What does President Paul E. Gray, '54, think of his first year in the presidency?

When Stephanie Pollack, '82, editor of *The Tech*, raised the question late last spring, President Gray replied quickly:

"I've spent far too much of my time on routine tasks—and far too little on long-term strategic planning," he told her. Accordingly, he reported two administrative changes late last spring:

☐ William R. Dickson, '56, vice-president for operations, assumed new responsibilities for matters affecting several administrative areas—including especially the development of budgets for the fiscal year 1983.

☐ Kathryn W. Lombardi, manager of Campus Information Services, took on additional duties as executive assistant to the president.

At the same time, Dr. Gray told Ms. Pollack that he wants to see more of the students. Beginning this fall, he said, he will schedule open office hours in an effort "to be accessible to students who want to seek me out."

William A. Martin, 1938-1981

William A. Martin, '60, associate professor in the Department of Electrical Engineering and Computer Science and the Sloan School of Management, died at his home in Brookline, Mass., on June 2 following an extended illness. He was 43.

In his work on practical applications of artificial intelligence Professor Martin was associated with the Laboratory for Computer Science and the Artificial Intelligence Laboratory; his interest in management led to the development of automatic programming techniques which are widely used. His most recent research had involved natural language processing and knowledge representation.

Professor Martin first came to M.I.T. as a freshman in the Class of 1960, and he continued at the Institute for graduate study (S.M. 1962, Ph.D. 1967) eventually to become a member of the faculty. Contributions in his memory may be made through the Alumni Fund to the William A. Martin Memorial Fund in the Department of Electrical Engineering and Computer Science.

Rudolf E. Gruber, 1892-1981

Rudolf E. Gruber, '16, whose support for foreign students and musical activities at M.I.T. won thanks from many students and faculty, died on April 9, 1981, following a brief illness in Boblingen, West Germany; he was 89.

How do you "get on—once you've gotten in"? More than 150 alumnae sought the answer to the problem of rising in the corporate environment at a day-long conference organized by the Association of M.I.T. Alumnae.

News of AMITA: Student Awards to Three Top Co-eds

Each year, AMITA (Association of M.I.T. Alumnae) gives an award based on academic excellence to a woman in the senior class. Factors that are considered in the selection are depth and breadth of academic accomplishments in coursework, special projects, thesis research, and grades.

This year, three students, Rebecca Henderson, Dinah Sah, and Eva Wu, were selected to receive the award, which was presented at AMITA's annual meeting at Endicott House on May 9.

Rebecca Henderson, of London, England, completed her degree in mechanical engineering in three years. After her first year at M.I.T., she spent the summer completing a fluid mechanics research project on water-cooled gas turbines at the M.I.T. Gas Turbine Lab. The following summer was spent doing market research for Data General/Europe. Her senior thesis, completed jointly between the Mechanical Engineering Department and the Center for Policy Alternatives, dealt with on-the-job satisfaction and intelligent automation in large-scale manufacturing. Her professors particularly supported her ability to incorporate socioeconomic, human, and institutional factors into her engineering solutions.

Dinah Sah, of Urbana, Ill., majored in biology. Her professors consistently described her as the best student in their classes. Her work in bioengineering and neurobiology received strong support. (She's done research on ion exchange during nerve impulses which contributed to ongoing studies of the control of membrane excitability in nerve and muscle.) One of her teachers summed up her work: "Her capabilities were not well tested by [my] course since she made no errors on any of the problems or any of the tests."

Eva Wu, of Jackson Heights, N.Y., double-majored in electrical engineering and mechanical engineering. By the end of her first year at M.I.T., Eva had accumulated over 180 units toward graduation. In five semesters she had accumulated more than enough units to graduate but chose instead to take two majors. A UROP (Undergraduate Research Opportunity Program) project in thin film solar cells yielded results which will be submitted for publication in the near future. While in the co-op program at Hewlett-Packard she designed a mini-floppy interface board for a terminal. Her evaluations for this work were outstanding. In addition, she was chosen the RCA/SWE Scholar at M.I.T. for 1980-81, and she won a design project award in the spring of 1980.

AMITA is pleased to have had the opportunity to recognize the outstanding achievements of these three women.

Ernst Levy, 1896-1981

Ernst Levy, a distinguished musician and composer who was Visiting Carnegie Professor of Humanities and faculty resident in East Campus at M.I.T. from 1954 to 1959, died on April 19 in Morge, Switzerland; he was 85. Mr. Levy came to the U.S. in 1941 and taught at Bennington College, the New England Conservatory, and the University of Chicago before assuming his duties at M.I.T.

Deceased

Joseph W. Wattles, '08; April 27, 1981; Cape Cod Nursing Home and Retirement Home, Lewis Point, Buzzards Bay, Mass.

John A. Christie, '09; April 17, 1981; 919 Hessel Dr., Akron, Ohio.

Rufus Crane, '11; December 25, 1980; 269 West William St., Delaware, Ohio.

William R. Holway, '12; April 23, 1981; 2472 E. 22nd St., Tulsa, Okla.

Burton L. Cushing, '13; May 13, 1981; 214 Howard St., Rockland, Mass.
F. Javier DeVarona, '13; 00-00-1979; Cisneros 157, Camaguey, Cuba.
Charlotte V. Sage, '13; May 30, 1981; 233 Walnut St., Brookline, Mass.
C. Shepard Lee, '14; December 6, 1980; 1616 Olive St., Santa Barbara, Calif.
John F. Staub, '15; April 13, 1981; 3511 Delmonte Dr., Houston, Tex.
Herbert W. Ellis, '16; May 16, 1980; 2401 Lost Tree Way, Bloomfield Hills, Mich.
Rudolph E. Gruber, '16; April 9, 1981; c/o John Sweeney, 14 Wall St., New York, N.Y.
Arthur F. Shuey, '16; May 11, 1981; 7800 Youree Dr., #204, Shreveport, La.
Frederick P. Upton, '16; May 12, 1981; 7219 Highbridge Rd., Bowie, Md.
William R. Willetts, Jr., '16; April 28, 1981; 17032 Burbank Pl., Encino, Calif.
Vertrees Young, '16; May 11, 1981; 1500 Youngs Rd., Bogalusa, La.
Robert C. Erb, '17; May 10, 1981; P.O. Box 537, Greenley Rd., New Canaan, Calif.
John A. Lunn, '17; March 30, 1981; 37 Larch Rd., Cambridge, Mass.
Howard B. Allen, '18; November 9, 1980; 305 Hamlet Hills, Suite 135, Chagrin Falls, Ohio.
Betram F. Jones, '18; 00-00-1979; 158 Clinton St., Somerset, N.J.
DeRobert H. Aborn, '20; December 1980; 2 Carlton Rd., Millington, N.J.
Ernest G. Bangratz, '20; March 8, 1981; 3330 Spanish Moss Terrace #102, Lauderhill, Fla.
Henry C. Haskell, '20; April 29, 1981; 60 High St., Box 548, Mossup, Conn.
Arthur G. Merriman, '20; August 10, 1979; 2641 N. Morland #12, Cleveland, Ohio.
Andrew J. McGowan, '20; April 4, 1981; 407 Stewart Ave., Garden City, N.Y.
Franklin T. Flaherty, '21; May 31, 1981; Battle Green Apt., 32A Worthen Rd., Lexington, Mass.
Robert R. Thurston, '21; March 4, 1981; 12123 S. Indian River Dr., Jensen Beach, Fla.
Marshall H. Winchester, '21; April 30, 1981; 124 Seymour St., Windsor, Conn.
Bernhard Gasser, '22; March 2, 1980; c/o H.G. Rogers, 3313 Orchid St., Pine Bluff, Ark.
Walter F. Christmas, '23; April 7, 1981; 3342 Tennyson St., NW, Chevy Chase, Md.
Clarence M. Cornish, '24; May 14, 1981; Margaritas 257, Mexico 10 DF, Mexico.
Stanley E. Davidson, '24; June 2, 1981.
H. Royce Greatwood, '24; May 27, 1981; c/o A.G. Tobey, 63 Beach St., Marblehead, Mass.
William McWane, '24; June 00, 1978; 2848 Southwood Rd., Birmingham, Ala.
R.S. Piroomov, '24; February 00, 1981; 349 Tuttle Pkwy., Westfield, N.J.
Richard N. Southgate, '24; February 7, 1981; 40 Middle Way, Summit, N.J.
Ello E. Richardson, '25; April 24, 1981; Elliott Dr., Williamstown, Mass.
Joseph E. Russell, '25; February 18, 1980; 10851 Pepper Ln., Houston, Tex.
William S. Bunnell, '26; January 21, 1981; 525 Elnore Ave., Temple, Penn.
John P. Larkin, '26; April 30, 1981; 4 Village Rd., Weston, Mass.
Carl C. Nelson, '26; September 24, 1980; 880 Q Ronda Sevilla, Laguna Hills, Calif.
Grant G. Speer, '26; April 4, 1981; 1722 S. Sherbourne Dr., Los Angeles, Calif.
George W. Bergman, '27; May 9, 1981; 7809 Corteland Dr., Knoxville, Tenn.
Francis B. Thorne, '27; April 20, 1981; 80 Woodbourne Dr., Ormond Beach, Fla.
Milo R. Williams, '27; November 11, 1980; 3540 Brandywine St., San Diego, Calif.
Carney Goldberg, '28; May 2, 1981; 300 Allandale Rd., Chestnut Hill, Mass.
George D. Mock, '28; April 28, 1981; 4224 Oakridge Lne., Chevy Chase, Md.
Edward J. Poitras, '28; May 13, 1981; 1411 Camino Del Rio E, Vero Beach, Fla.
John J. Scheibeler, '29; December 31, 1980; 69 High St., Mystic, Conn.
S. George Lawson, '30; April 22, 1981; 2600 S.E. Ocean Blvd., Apt. W-14, Stuart, Fla.
Carl Connable, '31; May 1, 1981; 10027 Lancaster Dr., Sun City, Ariz.
Donald E. Houghton, '31; May 4, 1981; 3701 Meadowbrook Dr., Ft. Worth, Tex.
Harold S. Rice, '31; May 25, 1981; 5 Briar Lne., Newtonville, Mass.
Clifford M. Smith, '31; December 14, 1980; 330 S. Ellison Ln., Waynesboro, Va.
Franklin W. Zwicker, '31; April 3, 1981; Box 72, Bristol, Maine.
Carroll Milton Daniel, '32; February 11, 1981; 4324 Alta Vista Lne., Dallas, Tex.
Farrow L. Tittle, '32; January 10, 1981; 3219 Audubon Rd., Montgomery, Ala.
John F. Yeager, '32; April 3, 1981; Box 101, Cochituate, Mass.
Loren H. Nauss, Jr., '33; February 18, 1981; 49 Daley St., Bristol, Conn.
Francis M. Sullivan, '33; April 27, 1981; 351 Paper Mill Rd., Newark, Del.
Theodore E. Graves, '34; October 00, 1980; Oak Point, Bozman, Md.
Elizabeth M.G. MacGill, '34; November 4, 1980; 3 Bennington Heights Dr., Toronto, Ontario M4G 1A7, Canada.
James B. Wadhams, '34; November 4, 1980; P.O. Box 223, Franklin, N.C.
Robert C. Blankenburg, '35; July 1, 1980; Rte. 2, Box 206A, Suring, Wis.
John Shaw Cort, Jr., '35; September 00, 1980; 16801 Fernway, Cleveland, Ohio.
S. Smallwood Fox, '35; March 24, 1980; 70 Colony Rd., Jupiter, Fla.
Wilson A. Taylor, Jr., '36; May 21, 1977; 44 Conway Cove, Chesterfield, Mo.
John R. Burns, '37; December 27, 1980; 330 Concord. Apt. #4B, Charleston, S.C.
Francis E. Neagle, Jr., '37; January 14, 1981; 103 E. 75th St., New York, N.Y.
Robert G. Bowie, '38; April 2, 1981; 65 Hickory Ridge Rd., Rochester, N.Y.
Francis P. Ford, '38; November 4, 1980; Oakwood Rd., Watchung, N.J.
Richard C. Adams, '39; April 5, 1981; 36 Woodchester Circle, Waltham, Mass.
George J. Coogan, '39; April 5, 1981; 96 Grover St., Everett, Mass.
Thomas L. Hansen, '39; April 1, 1981; 9207 E. Center Ave., Windsor Gardens, Denver, Col.
George A. Senior, '39; July 12, 1980; 919 East Main St., Maple Shade, N.J.
Harry E. Martin, '40; November 5, 1980; 2212 Fiesta, Newport Beach, Calif.
Frank S. Bonham, Jr., '41; January 8, 1981; 44 High Valley Dr., Chesterfield, Mo.
Robert J. Estes, '44; May 14, 1980; 1040 Campbell Ave., Lake Wales, Fla.
John L. Hunn, '44; March 23, 1981; 4108 N. Lake Dr., Milwaukee, Wis.
Joseph F. DeBold, '48; April 6, 1981; 5036 San Aquario Dr., San Diego, Calif.
Richard M. Sweeney, '48; April 16, 1981; 11600 Split Rail Ct., Rockville, Md.
Dewey J. Sandell, Jr., '49; March 8, 1981; Reis Circle, Fayetteville, N.Y.
Rex Shanks, Jr., '49; June 1, 1981; 3006 Reba Dr., Houston, Tex.
Thomas Mea, '50; April 1, 1981; 249 Fox Hill Rd., Burlington, Mass.
Jack Lowen, '51; December 2, 1980; 121 Pine St., Needham, Mass.
Kenneth H. Walijarvi, '51; April 22, 1980; 5905 Lee Valley Rd., Edina, Minn.
Joseph F. Kotrich, Jr., '52; May 8, 1980; 5353 Bayberry Dr., Cincinnati, Ohio.
Lawrence R. Krivit, '52; May 10, 1981; 109 Mountain Blvd., Watchung, N.J.
Warren N. Baxter, '53; November 9, 1980; 7400 Bissonnet #4238, Houston, Tex.
Peter G. Winchell, '53; January 12, 1981; 7201 Robert Ross Ln., W. Layfayette, Ind.
Winston A. Cartledge, '55; April 29, 1981; 1171 E. Rock Springs Rd. NE, Atlanta, Ga.
Ralph E. Harris, '60; January 4, 1980; 3810 Pueblo Way, Scottsdale, Ariz.
James J. Ritchie, '62; February 22, 1981; 73 Appletree Point, Burlington, Vt.
Susan C. Mortensen, '75; April 30, 1981; 8440 W. 108th Pl., Overland Park, Ks.

Classes

Mrs. Samuel Chamberlain stands beside a drypoint of the original home of M.I.T., the Rogers Building on Boylston Street in Boston. The print, by Samuel Chamberlain, '16, was recently on exhibition in the Margaret Compton Gallery. Mr. Chamberlain's class was the last to graduate from the building before the Institute moved to Cambridge. (Photo: Calvin Campbell)

13

Please note my new mailing address is 7 Brackett Point Rd., Biddeford, ME 04005. No, I haven't moved; still in the same lovely spot overlooking the ocean on the Maine coast. However, because our rural areas are getting so built up and overpopulated, the city decided to name and number all the short roads and lanes leading to the ocean. Is that progress? I liked the old way.

In our last issue, we briefly reported the death of **Laurence C. Hart.** Since then, we have received the following from the *Boulder Daily Camera* of Dec. 18, 1980: "Laurence Collett Hart, 1850 Folsom St., died Tuesday at Boulder Community Hospital. He was 89. Mr. Hart was born May 8, 1891 in Dayton, Ohio, to Samuel F. and Clara Burns Hart. He married Bernice Eva Van Allen in Dayton on August 9, 1913. She died in 1948. On Oct. 3, 1949, he married Arrietta Wheat Davis in Chicago. He was a vice-president for personnel management with Johns Manville and retired in 1956. He was a graduate of Stivers High School, Dayton, and of the Massachusetts Institute of Technology in Boston. During World War I he served with the FBI. He came to Boulder 9 years ago from Larchmont, N.Y. He was a member of First Presbyterian Church, Sigma Alpha Epsilon fraternity, and a 62-year member of Oak Lawn Lodge in Oak Lawn, Ill., and Medinah Temple in Chicago. Survivors include his wife, Arrietta, of Boulder; a daughter, Bernice Tompkins, of Sherman Oaks, Calif.; a sister, Gladys Dow, of Bradenton, Fla.; three grandchildren; and two great-grandchildren."

We have received a lovely card stating simply: "In Loving Memory of **Stanley Wallace Parker,** born Jan. 31, 1891, Waltham, Massachusetts. Passed away January 6, 1981, Palo Alto, California."

We regret to report the death of **Arthur W. Carpenter.** His obituary read, in part: "He was too old to be drafted into World War II, but early in the war, and after it was over, his government called on him to lend his expertise to a national effort. Mr. Carpenter, then manager of the B.F. Goodrich testing laboratories, complied with each request. The renowned chemist died Friday (January 2, 1981) at age 90 after a long illness. He resided at 943 Genesee Rd., Akron. A veteran of World War I, he agreed to serve on the War Production Board in 1941. He was on the board for a year, specializing in rubber conservation. The government again turned to him in 1948, and he served on the National Securities Resources Board for three months. When he left Washington, he was presented a distinguished service award 'for outstanding contributions to the work of the National Security Resources Board and devotion to the welfare of his country.' Mr. Carpenter, born in Akron, was graduated from the Massachusetts Institute of Technology in 1913 with a master's degree in chemical engineering. He was named city chemist for Alliance and then worked for the Akron Water Department. He joined Goodrich in 1927 and became manager of the laboratory the next year. He retired in 1957. Mr. Carpenter was a member of several professional societies and was past president of the American Society for Testing Materials. He leaves his wife, Irma, and a cousin, Angeline Whiting, of Akron."

Also, we received a notice from the Alumni Office of the death of **Charles H. Wood** on March 15, 1981. He had been in a nursing home for some time.

We are indebted to **Warren Glancy** for the clipping from the *Boston Herald* of May 15. "**Burton L. Cushing,** 90, of Rockland, formerly of Quincy, retired head of the science department of the Boston school system, died yesterday at Quincy City Hospital. A graduate of M.I.T. and holder of a master's degree in education from Harvard, he was in the Boston system 40 years. After his retirement, he taught at Thayer Academy and Fisher Junior College until he was 80 years old. He was the author of several high school science textbooks and lectured at the Harvard Graduate School of Education. Active in civic affairs, he was a former chairman and trustee of the Rockland Public Library and a member of the Rockland Chamber of Commerce and Kiwanis. He leaves a son, Donald L., of South Weymouth, and a brother, Lester, of Lowell." Burt was always a faithful participant in reunions and Technology Days.

We hope that some members of 1913 attended Technology Day on June 5 and will keep us advised of newsworthy events.—**Rosalind R. Capen,** Assistant Secretary, 7 Brackett Point Road, Biddeford, ME 04005

16

This is being written on the eve of our 65th Reunion. We expect 14 classmates and 16 guests to join us for this noteworthy event. We regret that the many others who wanted to be with us were not able to make it. Among these are **Don Webster** who wrote: "I have had some physical upsets which prevent me from enjoying the reunion. Marjorie and I live quietly on Cape Cod and seldom leave it. I haven't been in Boston in three or four years." . . . From **Doug Robertson:** "I am sorry that both Bettina and I feel that we are simply not up to it. Healthwise, we are about the same as we were when we saw you, but we get tired so quickly that we would not take our share of fun to the party." . . . From **Charlie McCarthy,** who wrote of Betty's recent illness: "She will need several weeks of home rest to build up her strength again before she will be able to travel. We had looked forward to being with you and are disappointed that we have to forego this pleasure. All best wishes to the hardy 1916ers who make it to Endicott House."

Dina Coleman had to cancel out at the last minute. We also had nice notes from Grace Dodge, Dolly Stone, Pearl Wilson, Lois Lawrance, Margaret Fleming, Ruth Best and Mrs. Herb Gfroerer . . . . We had this nice letter from **Will Wylde:** "I am sorry to be so late in responding to your request as to whether or not we could come to the 65th Reunion this June. I am afraid that again we cannot make it. Donnie and I regularly go up to the Western Mass. area each fall to attend a Wylde family reunion which is held annually there, so a second trip just seems to be too much. I am enclosing a copy of a letter which I have just mailed to M.I.T. Professor Emeritus Harold Weber, '18, which may be of some interest to you. Professor Weber has written a book telling about the formation of Course X at M.I.T. from the very beginning. The book was sent to me by James Donovan, '28, of the Alumni Association with the suggestion that I might want to write Professor Weber in appreciation of it. So I have written the enclosed letter and sent it to Mr. Donovan and asked him to forward it along to Professor Weber if he felt it was worthwhile. **Barney Gordon** and **Don Webster** are two other members of the class who were in Course X and who seem regularly to attend the reunions. They might be interested in reading this letter, so if you wish and if they are present at this reunion, by all means pass it along to them."

We regret to announce the deaths of **Art Shuey** and **Vert Young.** Art's wife, Mildred, wrote us as follows: "I think Arthur wrote you that he could not attend the 65th Reunion. He was becoming very weak and could not get around, and finally died at 2 a.m. on May 11. That morning, a telegram addressed to him stated that Vertress Young died at 6:30 a.m. that day. They had enjoyed the 50th Reunion together. His wife and I had enjoyed going to a later class reunion with them, and also shared a condominium in Aspen for the wonderful M.I.T. Summer School. When I phoned in response to the telegram, it gave us both some consolation that the two long-time friends had passed away the same morning. They both loved their red jackets!" May they, and all our departed classmates, rest in peace.

Keep breathing . . . . Keep walking . . . . Keep eating . . . . Keep drinking . . . . Keep writing . . . . Everything in moderation.—**Ralph A. Fletcher,** Acting Secretary, West Chelmsford, MA 01863.

17

The death of **Robert Curtis Erb** occurred May 10 at the Stamford (Conn.) Hospital. Bob had a gall bladder operation last January, but the convalescence was difficult. He was born in Worcester, Mass., lived in Nashua, N. H., and latterly in New Canaan, Conn. He served with the army's Chemical Warfare Service in World War I and several state and federal war committees in World War II. He was president of the J.F. McElwain Co. of Nashua (a manufacturing subsidiary of the Melville Corp.) for 10 years before being chosen in 1956 to be head of the parent company, which owns the Thom McAn shoe chain. He is survived by his wife, Elizabeth (Pat), and Robert Jr. of Waterville, N.H. A memorial service was held at St. Aloysius Roman Catholic Church in New Canaan.

From **Ken Lane** in Miami we have the following: "My humble apologies for my delay in responding to your 'Mayday' call of March 5. My only excuse is a chain of house guests and the pressure of my official duties as a staff officer of Flotilla 65 of the Seventh District, U.S. Coast Guard Auxiliary. If you insist on twisting my arm, I'll agree to take care of the preparation of the '17 notes in one of the issues.

As for the choice of issue, I'll leave it to you; it should not be in the distant future. I might in the meantime be run over by a trolley car or gunned down by a jealous husband. Would you tell Ray that somewhere around here there is a half-written letter in response to his request for my disclosure of the sordid details of my current activities. I fully intended to complete and forward it, but in the light of the foregoing, I think it is wiser to save my confessions for the issue for which I have so recklessly assumed responsibility."

You can guess from the above that our notes for October, by Ken, will be rather special.

Our honorary member Don Severance, '38, was given a special birthday party on April 27, prior to the Alumni Council meeting. Arriving at that ripe old age he continues his M.I.T. connection as director of leadership gifts. He says that "65 doesn't mean as much these days as it used to" and that he "talked with Dusty Wilson when in Cleveland on May 4; he sounded great on the phone."

For **Al Lunn,** the Cambridge City Council passed unanimously a many-pointed resolution to go on record "as expressing the gratitude of the City of Cambridge for his many contributions to his beloved city and country".

Some of the most active and loyal '17ers are wives or widows, and not the least loyal and active is in Mexico City. From there **Conchita Lobdell Pearson** attends almost all the M.I.T. alumni gatherings in Mexico. She has also attended a number in the Boston-Cambridge area, even after Lobby died. Last February she went to Tampa to attend the M.I.T. Florida Fiesta at Cypress Gardens. Conchita's comments on the M.I.T. Mexican Fiesta are tempting for any of the class who may travel below the line.

In recognition of Conchita's interest and activities over the years, she was elected to honorary membership in the Alumni Association, with the announcement being made at the Technology Day luncheon.

Chet Ames is confined with serious leg problems. His apartment is on Pond Street in Winthrop overlooking the water, and Mrs. Ames expressed the hope that any of his friends who get to Boston might drive out to see him.

Tubby Strout finds himself pretty much restricted to his Cape Cod environs. He gets to Boston once in a while to go to Commandery, dependent on a fellow member and driver.

Walter Lyon writes from Nashua, N.H., "I had my 90th birthday last October. I still enjoy excellent health and have retained all of my faculties, for which I am grateful. Upon the advice of one of the student advisors at Tech that at least three years of teaching would round out our education, I took his advice and liked it so much that I kept on for 45 years and became head of the science department. Twenty years ago I retired and have kept busy ever since. I became interested in antiques and old houses and did very well with both. After retiring a second time, I started collecting miniatures as a hobby and have now added stamp collecting as another hobby." Walter's address is: 7 Farmwood Dr., Nashua, NH 03062.

Cornelius C. Coakley, from Richmond, Vir., sends a long and interesting letter about his research days at Tech: "It was with surprise, pleasure and delight that I received Prof. Harold Weber's ('18) *The Improbable Achievement: Chemical Engineering at M.I.T.* It brought back my own relation to the formation period of chemical engineering. I spent my senior year at the new Tech in Cambridge. Those of us who studied under Col. Walker and Prof. Lewis were most impressed by their dedication to the development of chemical engineering. The war brought forth special problems that M.I.T. could help solve. M.I.T.'s role was promoted particularly because of Col. Walker's direction of the new Chemical Warfare Service.

"The navy had a problem of carbon monoxide poisoning in submarines, and M.I.T. Prof. Mueller was assigned this study project. I was one of a number of seniors Tech was apparently sure would graduate, and we were offered our graduation without further study if we would elect to accept an assignment to work on a research project. I elected to take an assignment under Prof. Mueller. The idea of the project was that if carbon monoxide poisoned people by its reaction on red blood cells, why not use red blood cells to absorb carbon monoxide? My first task was to get a supply of red blood cells. There was a slaughter house near Tech, and I would fill a pail with blood and then walk through the streets to Tech spilling a trail of blood along the way. Did that attract attention? I would then separate the plasma from the red blood cells and run an absorption test of carbon monoxide by the blood cells. The result? The idea was a success, but in practice didn't work out—for reasons you can readily suspect.

"The army gave me an industrial furlough with Benzol Products Co. (a forerunner of Allied Chemical & Dye Corp.) of Marcus Hook, Penn., to produce khaki brown dye for army uniforms. The Marcus Hook plant was also producing tear gas and sneeze gas. I stayed on with Allied and moved with the Marcus Hook plant to the Buffalo, N.Y., dye plant where I stayed for 35 years, ending up as plant manager. Then I spent a couple of years at New York office, came to Hopewell when Allied started up the nylon textile fiber plant, and retired 1962. I'm still alive and kicking."

With regret we record the death of **Merrill C. Lee** in Richmond, Vir., on March 3. He spent his business life in private architectural work, mostly for schools and hospitals.—Secretaries Pro tem: **Raymond S. Stevens,** 100 Memorial Drive, Cambridge, MA 02142 and **Stanley C. Dunning,** 33 Christian Ave., Concord, N.H. 03301

18

Though our numbers are dwindling, time has become more precious to those of us still here. Our yearend greetings enable me to fill these columns. I am grateful to so many of you who still care for 1918 and M.I.T.

Back in December **Mal Baber** wrote that he had another heart attack, not severe, and that he was convalescing slowly. He commented, regarding "rugged individualism versus the social welfare—small business (the strength of the country) is being strangled by governmental red tape. The new rugged individualist (and successful) is the mobster, the mafia, the tax evader, etc."

I am happy to quote in part a letter from **Bill Foster** of January 6, 1981: "The class notes indicate that our colleagues are shrinking in number, and this is, of course, inevitable and I hate to see it happen. My own activities have been considerably reduced over the last few years because of various health problems, but I continue my interest in the Institute and in our class associations. We still live in Washington and keep up with many connections from the past, but I now am most frequently emeritus, rather than an active participant. I still keep in touch with arms control matters from the outside, but technically I am only a consultant. I hope through your notes on the class to remind my classmates of my continued interest in them, and I sincerely hope that we at least will be able to make the 60th Reunion in 1983. I am not in a wheelchair yet, but am somewhat dependent on a cane for mobility."

A much later note, dated April 16, brings this welcome news from **Howard Cyr:**

"I have been a poor correspondent lately because nothing of interest to you or my classmates seems to happen to me. My wife and I 'commute' each spring and fall between our summer home in Pennsylvania (near where we have a son and six grandchildren) and our winter home here in Florida, where we enjoy our beach, dock and boat. We travel by means of the Auto-bus (not the Auto-train). The headquarters of this small company is near our Penn. home. If we start one morning, leaving our car with this company, we are in Florida the next day's evening and find our car waiting for us—it having been carried on a car-carrier. The one night on the road is spent in the comfortable Holiday Inn of Lumberton, N.C. If you ever get to this southland, please do visit us."

Faithful **John Abrams** is still receiving much fan mail resulting from the newspaper publicity of Los Angeles versus Bishop. The big city is trying to take too much water from his beloved Bishop.

A handsome history of the M.I.T. chemical engineering department has been written by **Harold Weber.** I am indebted to Jim Donovan, '28, for a copy of it together with this background on Harold. Congratulations on a history well done. Jim writes, "Chemical engineering at M.I.T. was part of the chemistry department until 1920, at which time it was organized as a separate department. In commemoration of its recent 60th anniversary, a history of the department's early development has now been published. The author is Harold C. Weber, who was a student at M.I.T. on Boylston Street. He came across the river in the Ark, was in the military as a radio instructor at the beginning of World War I, and then was in the Army Chemical Corps when it was formed. He was a member of the staff when Course X was organized as a separate department. Harold himself taught many of us, liked all of us, and even though retired, still thinks of, visits, appreciates the Institute, the department, and the alumni. As professor emeritus he carries on.

"As an alumnus you are naturally interested. The department has always been a teaching department; its product, the flower of its efforts, has been its alumni. Harold conceived of this book as a simple history for the benefit of the department and the extended department—the alumni. He, with some assistance by the staff, prepared it."

Each of you may be prompted to recall other aspects of the department's history and you may wish to write Harold or other acquaintances of whom you are reminded. The department would be delighted to learn more about itself from you, and the Alumni Association would be pleased to assist you in ascertaining the current whereabouts of old friends.

I record the death of **Stuart Elliott** on March 27 and **Nemesio Alvare**—exact date not available.—**Max Seltzer,** Secretary, 1443 Beacon Street, Brookline, MA 02146 and **Leonard I. Levine,** Assistant Secretary, 519 Washington Street, Brookline.

20

Welcome word from **Benjamin West** of 5801 E. Livingston Ave., Columbus, Ohio. Ben has lived in Columbus for 61 years. He lost his wife several years ago, but has four married children, 13 grandchildren and nine great-grandchildren. Can anyone in the class match this proud record?

A few days ago Amy and I attended a delightful party in Plymouth to celebrate **Perk Bugbee**'s 60th wedding anniversary. Perk and Nina have stood the years well. He was surrounded by his three beautiful granddaughters and handsome grandson. A felicitous occasion. Perk was recently the guest of honor at the National Fire Protection Association's 60th anniversary and the opening of their huge, new headquarters in North Quincy.

It is my sorrowful duty to report the passing of some well-known and beloved classmates. **Heinie Haskell** died April 29 at his winter home in Hilton Head, S.C. He established a worsted mill in Moosup, Conn., the Brunswick Worsted Mills, and served as chairman of the board. He was born in Brunswick, Me., and graduated from Bowdoin before coming to M.I.T. to earn a degree in aircraft engineering. He served on the finance committee and the board of selectmen in Moosup and was active in a number of charitable and community organizations. He founded the First National Bank of Plainfield and was chief executive officer before its merger with Connecticut Bank and Trust Company. He leaves his wife, Emily, two daughters and three sons, 15 grandchildren and a great-grandchild. . . . **Bob Warriner** of 73 Llewellyn Drive, Westfield, Mass., died on March 3. Bob's entire business career was with the William Carter Co. textile manufacturers. He leaves his widow, Winifred, two daughters and six grandaughters. . . . **Lancy Snow** of 309 Marius Road, Venice, Fla., died on December 27. Before retiring to Florida, Lancy was structural engineer of New York State's Department of Public Works at Albany. He leaves his wife, Irene, and two daughters. We are happy that they were able to be with us at the 50th.—**Harold Bugbee,** 21 Everell Road, Winchester, MA 01890.

21

These notes are being written late in May, just a few days before our 60th Reunion. As of now, it looks as if 30 classmates will attend and about 20 wives. A recent letter from assistant secretary **Josh Crosby** reports the deaths of Helen (Mrs. **Garvin**) **Bawden** and Bea (Mrs. **Thomas**) **Dutton.** Tom Dutton is planning to leave Sarasota and go live with his daughter in Austin, Tex. Our deep sympathy goes out to Tom. . . . **Larry Buchner,** in a letter addressed "Dear Friends and Fellow Countrymen," enclosed a *Reader's Digest* reprint entitled "Bonanza! America Strikes Gas." The reprint tells about the huge amounts of natural gas being discovered by deep well drilling and expresses the hope that this may solve our energy crisis. Larry spent many years of his business career in the study of how to heat buildings more efficiently. His latest letter discusses the use of heat pumps, thermostatic control, and how to heat homes efficiently. . . . **Horace Tuttle** wrote: "Pearl and I are sorry we can't make the 60th Reunion at M.I.T. My blood pressure was so low I passed out at a Sunday luncheon with several of our friends. Pearl is the opposite—doctoring for high blood pressure. My five-year hitch as a deacon of the Congregational Church is over. Pearl and I had our 59th wedding anniversary on May 9. We both have been members of the Masons and Eastern Star for 60 years."

A letter dated April 30 from **Ted Rose** of Sierra Madre, Calif., to reunion chairman **Don Morse** said, "I have been looking forward to the 60th with great enthusiasm, but it ain't going to happen. I go into the hospital on May 3 for cancer surgery. Prospects are favorable, but it puts me on hold for a couple of months. I'm sorry to miss the boat again." . . . A postcard from **Jack Rule** said: "Just a note to let you know we are moving. After July 1 our address will be 600 Camino Del Monte Sol, Santa Fe, N.M. 87501. Sorry to miss the reunion, but I'm immobile. We'd love to be there."

One death is reported this month: **Irving D. Marshall** of Iowa City, Iowa, in August 1978.

That's all for this month. Reunion news will be in the next issue.—**Sumner Hayward,** Secretary, 224 Richards Rd., Ridgewood, NJ 07450; **Josiah D. Crosby,** Assistant Secretary, 3310 Sheffield Circle, Sarasota, FL 33579; **Samuel E. Lunden,** Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22

Our theme of the month is the 60th Reunion plan for 1982. Many classmates have expressed satisfaction with our activities at the 55th, including Alumni Day and the facilities on the campus with a continuation at the Spalding Inn Club in Whitefield, N.H., in the White Mountains. A May newsletter from **Randall (Bunt) Spalding** shows the beautiful club building, golf and bowling greens, and tennis and swimming facilities amid colorful surroundings near Lake Winnipesaukee. The arrangements should certainly be for comfort and good fellowship and not for speed. Please write telling of your interest and preference.

Don Carpenter has written a review of 1922 Scholarships, Professorships and Career Development Programs that have been especially valuable both directly and as encouragement to other classes at the Institute. Don has reviewed these efforts, starting with the decision at our 40th Reunion in 1962 to inaugurate the Class of 1922 Professorship Fund, which was added to the Ray Rundlett Scholarship Fund. The result was the biggest endowed professorship at M.I.T. An additional fund was later provided to encourage undergraduate teaching. At successive reunions, the Career Development Professorship was added to assist a junior instructor, with the later addition of another career development professorship and a senior professorship. Since there will be changes each year to this vitally important program, we are to be notified of professorship awards annually. This entire program stands as a tremendous achievement for the Class of 1922.

In the May issue of *Tech Talk*, a story headlined "Michael Meyer to hold Class of 1922 Chair" emphasizes the importance of recognizing professors of exceptional promise and unusual devotion to teaching. We are indebted to Don Carpenter for this great concept leading many other classes in their efforts for endowed chairs.

We are happy to hear from **Abbott L. Johnson** at Phoenix that he has been playing three or four rounds a week of golf under perfect weather conditions. He compliments the Institute again on its fortunate choice of Paul Gray for president of M.I.T. Ab's wife, Dottie, enjoyed an around-the-world trip on the Rotterdam last spring while he exercised at the Phoenix Country Club. . . . Our unusually active president, **Parke Appel,** has continued his coordination of M.I.T. activities during the winter at Venice, Fla. He has been helping people in their IRS efforts for the last five years and has invited in M.I.T. grads and spouses to hear Hugh Dardin describe life income plans, including tax advantages. Parke was handicapped last December by stepping off an elevator that did not quite level at his floor. He fractured five bones in his left foot and ankle. However, he still keeps busy with the Telephone Pioneers and their monthly activities. Parke is presently vice-president of Harbour House Board of Directors, with 28 families to criticize the work. Parke and Madaline spent May in Spain to enjoy visiting daughter, Joann. In the meantime, they have celebrated their 57th wedding anniversary. He has heard from **Milt Manshel** and **Oscar Horovitz** offering suggestions for our 60th. . . . Aline and **Ray Ellis** attended the festival in Cypress Gardens this spring and enjoyed visiting with President Gray and the Appels. Ray has been playing tennis and attending tournaments in New England and Florida as No. 1 in the over-80 class. He has been active in the Lifetime Learning Group in Sarasota and has given talks on the Soviet Union and energy. He appeared for two hours on local TV about the situation in the U.S.S.R. They are now in Camden, Me., phone (207) 734-6687 (Beachhaven). **David H. Harris** is their neighbor.

Our sympathy goes to the family of **John O. Bower** of Shelburne, Nova Scotia. He had been chief geologist in the Argentine for Texaco and later became chief executive officer of Colsag Corp. for Mobil Oil. He was a Capital Progressive Conservative member of Parliament. . . . We also regret the passing of **Brian Mead** of Scarsdale, N.Y., and send our sympathy to his widow. . . . We regret the loss of **Harold MacDonald** who had retired as chief executive of Household Finance Corp. to his home in Boca Raton, Fla. He had joined Household in 1948 and was elected president shortly thereafter as it became the largest company of its kind in the U.S. and Canada. He is survived by his wife, Bernice, and his sister and brother. . . . We have just received notice of the passing of **Lawrence H. Connell** of Haines City, Fla., on September 5, 1979. Our sympathy goes to Mrs. Helen Connell. . . . Our sympathy goes to Iris Freedman of Plattsburg, N.Y. for the loss of her husband, **Leo H. Freedman,** in May 1980. . . . Also to the family of **Harmon A. Poole** of Litchfield, Conn., we extend our sympathy. Harmon Poole was the manager of several Bendix plants during World War II and was a management technical consultant for a number of businesses. . . . Also we regret to report the loss of Cmdr. **Donald I. Gross** of Asheville, N.C. in February. Our sympathy goes to his wife, Lottie A. Gross. . . . We have just learned of the death last year of **Bernard Gasser.** Our sympathy is extended to his family.

We close with the hopes of more news being received at Alumni Day, and letters and cards from you all. Good luck and good health.—**Whitworth Ferguson,** Secretary, 333 Ellicott Street, Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Seccretary, 3001 South Course Drive, Pompano Beach, FL 33060

23

Marge and **Tom Rounds** have bought a place in Green Valley, Ariz., and will move there from Heritage Village, Conn., in September. The move is for relief of Tom's asthma. The new address is 212 N. Calle Acquarela, Green Valley, AZ 85614. . . . . A long letter from **Billl Glendinning** tells of his considerable success in the publication of a number of books relating to preparation for the New York State examinations for the license of professional engineer. His wife, Ester, died a few years ago. Bill was born in Maxwelltown, Scotland, and came to this country with his family in 1898. He was enthusiastic in his praise of his experiences at the Institute, which included five years as a staff member in the Department of Electrical Engineering. . . . The **James A. Henderson** Memorial Lecture for 1981, "Synfuels Superprojects: New Challenges for Project Management," was delivered by Edward E. David, Jr., ScD. '50, president of Exxon Research and Engineering Co. on April 30. The lecture series has been made possible by the generosity of the friends and associates of our late classmate.

Prentiss B. Alger died on August 26, 1980. He graduated in electrical engineering, and through 1948 he was sales engineer for Sprague Electric Co. and was involved in electric power station design. He served two years in World War I and two years in World War II. After World War II, he was a statistician in the quality control area with the U.S. Air Force, retiring in 1965. He was a member of the Richard C. Maclaurin Lodge, AF & AM, and a member of the Appalachian Mountain Club. . . . Comdr. **Julian S. Loewus** died November 26, 1980. He graduated in naval architecture and marine engineering, and took graduate courses at Harvard and Johns Hopkins universities in economics and business administration. After working with several construction companies, he became an assistant structural engineer with the war department and a draftsman with the navy department, then joined the Lighthouse Service as a junior engineer, became an assistant lighthouse engineer, then was appointed lieutenant (j.g.) in the Coast Guard and attended Chemical Warfare School at Edgewood, Md. He rose to the rank of lieutenant commander and became chief of chemical warfare activities. He was appointed chief of the damage control group in the Naval Engineering Division, which had charge of firefighting, chemical warfare, collision damage, and emergency repairs. He investigated the establishment of a Coast Guard School for Damage Control at Fort McHenry, Md., and organized a fleet of navy fire boats equipped and manned by the Coast Guard. He was designated a gas identification agent and a member of the International Association of the Chiefs by the navy department.

Rear Adm. **Paul Nibecker** died June 30, 1980. He graduated from the Naval Academy in 1920 and received his M.S. in naval construction and engineering at the Institute in 1923. He specialized in ship design and construction and became design superintendent at the Boston Navy Yard. After the outbreak of World War II, he became production officer at the Puget Sound Navy Yard. Rising to rear admiral, he became chief of industrial relations in the office of the undersecretary of the navy, and later became commander of the Brooklyn Navy Yard. He was a member of the Richard C. Maclaurin Lodge, AF & AM, and a founding member of the Army-Navy Country Club, Arlington, Vir.

Albert G. Thomas died February 11, 1979. He received an electrical engineering degree from the University of Virginia in 1921 and an M.S. degree in electrical engineering from the Institute in 1923. He was a research engineer and inventor. Having established the General Research Corp. of Lynchburg, Vir., he then was associated with the Auto-Ordnance Corp. of Greenwich, Conn.; the Office of Scientific Research and Development, in charge of patent work; Controls Laboratories, Inc., of Worcester, Mass., as consultant and director of research; and the Industrial Research Institute of Chattanooga, Tenn., in charge of engineering research and development. He orignated, and filed in the U.S. Patent Office, more than 100 inventions in many fields.

John H. Thompson died December 23, 1980. He graduated in electrical engineering and began his career with New England Telephone and Telegraph Co. as assistant engineer. In 1926, he moved to Public Service Electric and Gas Co., in Newark,

where he served in various capacities in the electric distribution department until his retirement in 1969. He was very active in yachting and in civic affairs in Riverton and Moorestown, N.J.—**Richard H. Frazier,** Secretary, 7 Summit Ave., Winchester, MA 01890.

24

We lost one of our most enthusiastic and supportive class members, **Nish Cornish,** on May 14, 1981 in Mexico City, Mexico. Details have not been available, but it is thought that he had respiratory difficulties. Nish earned his S.B. in engineering management and was active in a number of clubs and societies at the Institute, especially *Technique,* for which he was managing editor his senior year. He went to Mexico City as general manager of an American company, Underwood Mexicana, an office equipment producer, and retired after 20 years as president and managing director of Hobart Dayton Mexicana, **Dave Meeker**'s company. He and Luisa always excited our class get-togethers by bringing Mexican wares as prizes and souvenirs. In the 1949 class questionnaire, Nish expressed the sentiment of a number of mates in foreign assignments who wished to see their families grow up and prepare the children for life. Clarence Martin, Jr., '50, was a perfect example. The class extends its sympathy to Luisa and the four children.

Max Ilfeld writes us from Albuquerque, N.M., to say he's sorry that he and Bertha will not attend Woodstock, Ver., Mini. They are healthy probably because they go to California in the winter and Taos, N.M. in July and August. He continues to enjoy painting (pictures, that is), although at one time he had a builders' supply business.

Leland K. Franke passed away in Rochester, N.Y., on December 13, 1980, according to a note from his wife, Lucy. He was awarded an S.B. in electrical engineering and was a member for three years of the Masonic Club and E.E. Society. Apparently he spent his career with the Rochester Gas & Electric Corp.

Frederic G. Garrison died during January 1980 in Tempe, Ariz. Garry prepared at the University of Chicago, then entered the Institute in his junior year and obtained an S.B. and S.M. in electrical engineering, cooperative course. He became a resident engineer for Binks Mfg. Co., Detroit, Mich., and later, owner of Progressive Equipment Co., Detroit. . . . The death of **John J. Stanton** in Framingham, Mass., on February 20, 1981, was reported by the Alumni Fund. Jack received his S.B. in general engineering after preparing at Clark University. He was cox of his junior class crew.

Ruth and **Paul Tishman,** noted New York builder, art collector, and founding chairman of the Council for the Arts at M.I.T., had a private viewing of their African art collection in June at the Metropolitan Museum of Art. The collection is considered among the finest in the world, representing many years of searching and acquisition. An 18th-century bronze helmet mask, one of three known, was used in the royal Ododua ceremony to protect the king. . . . **Don Moore** has made a good recovery from his lumbar spine injury. . . . **Frank Shaw** maintains his status quo at the Wellesley Manor Nursing Home in Wellesley. He has talked about adding a Honda motor to his wheel chair.—**Russell W. Ambach,** Secretary, 216 St. Paul St., Brookline, Ma 02146; **Herbert R. Stewart,** Co-secretary, 8 Pilgrim Road, Waban Ma 02168

25

The class was well represented at the April meeting of the Alumni Council. Present were **Jim Howard, Ed McLaughlin, Sam Spiker, Courteney Worthington** and your secretary. **Will Gardiner,** who is a regular attendee, missed this meeting—being indisposed. . . . A telephone call early in May from our president, **Ed Kussmaul,** indicated he had returned from his winter sojourn in Briny Breezes, Fla. . . . It has been previously noted that **Sam Glaser's** son, Paul Michael, is well known as Starsky of the TV show "Starsky and Hutch." A Boston newspaper item in May featured a short article noting that he had paid a visit to his ailing dad at the Beth Israel Hospital. Hope by the time this reaches you that Sam has fully recovered.

A note from **Anthony Tsongas** via the Alumni Fund tells us that he spent January and February in Florida. Next year he plans to go back to his beloved Mexico. He usually plans to spend a week in Guadalajara, which has a delightful climate, and then he flies to Mazatlán, which has good beaches and many very fine hotels and restaurants. For the amateur archeologists, he recommends Yucatan with its Maya ruins, Oaxaca and Mexico City with its pyramids, and the incomparable Museums of Anthropology.

Most belatedly we have received word that **Paul P. Wiant** died in Cincinnati, Ohio, on October 22, 1973. Two other deaths have been reported: Dr. **King E. Gould** in Rumson, N.J., on January 5, 1981, and **Jeremiah P. Harrington** in Ventura, Calif. on March 8, 1981.—**F. Leroy (Doc) Foster,** Secretary, 434 Old Comers Rd. (P.O. Box 331), North Chatham, MA 02650

26

As these notes are being typed, there is only a week remaining before our 55th Reunion at Chatham, which appears to be setting a record for attendance. Unfortunately several of our classmates were forced to cancel their plans at the last minute: **Dave (Crockett) Harrison,** whose wife had open-heart surgery recently—she is recovering nicely, but is not quite up to the trip; **Argo** and Edna **Landau,** the latter's mother being in precarious health; and most regrettably, **Jack** and Edith **Larkin,** due to Jack's death on April 29. Edith writes, "He was so looking forward to the 55th. He had been ill for several weeks but quite sudden at the end."

A recent clip from the Quincy newspaper tells of the selection of **Don Cunningham** as representative of Southeastern Massachusetts in the New England Council and tells also of his service as vice-president of the Hersey Products Co. and as a member of the executive board of the American Association of Industrial Management. . . . A note from **Byrd Kelly** to **Cheney "Pink" Salmon** refers to his plans to attend the reunion. He writes, "It will be nice to see you again (you transferred from Mass. Aggie, I transferred from Brown, and **Jim Killian,** from Duke and Trinity College). You see we have something in common. I couldn't have passed the first two years." . . . A note from **Pete Loomis** says, "I finished at U. of Michigan. Am broke and happy." . . . A letter from his wife advises of the death on January 21 of **Bill Bunnell.** They had been living in the Reading, Penn., area since Bill started working for Consumers Gas Co., which became U.G.I. the same year that he became vice-president—1956. . . . A delayed notice just received is of the death of **Carl Nelson** in September 1980.

We have just received a copy of the Alumni Office's record of addresses of our class; it will be available at the reunion. There are listed 374 living, 151 deceased, and 73 for whom there are no addresses available.

In the next issue, we plan on reporting the events of the reunion to those who were unable to attend. Until then—**William Meehan,** Secretary, 191 Dorset Rd., Waban, MA 02168

27

The Alumni office has forwarded the following news items, somewhat condensed:

Over a year and a half ago, in April 1980, **Laurence H. (Larry) Coffin** of Ellsworth, Me., completed a weather study course, Meteorology I and II, at the Maine Maritime Academy in Castine and received a certificate with congratulations from Rear Adm. Edward A. Rogers. Larry retired from Goodyear International Corp. in 1970 and moved to Maine. He joined Goodyear after graduation and spent many years in manufacturing operations overseas, primarily in Argentina and Brazil; after World War II, he travelled to all parts of the world. Since retirement, Larry has been an active consultant to the Academy and a staff officer on board the training ship S.S. *State of Maine.* He has gone on cruises to Bermuda, the Caribbean, and the Mediterranean, and participated in the Tall Ships parades. Belated congratulations to you, Larry, and we hope you and Helen will join us at our 55th Reunion.

Frank Massa, board chairman of Massa Products Corp. in Hingham, is still very much in the forefront of his specialized field, sonar ultrasonic devices. He presented a talk at a meeting of Sonics and Ultrasonics Chapter at his plant on May 7, describing the long history of development that he and his firm have contributed to the state of the art. From 1928 to 1940, Frank was senior acoustics research engineer for Victor Talking Machine Co. (later RCA-Victor) and pioneered in the early development of the phonograph pickups, microphones, and loud speakers used in the earliest Victor radio phonograph sets. This was followed by development of sound-power telephones and battle-announce equipment for use by the U.S. Navy. From 1940 to 1945, he was director of acoustical engineering for Brush Development Co., where he designed and manufactured numerous types of sonar transducers utilizing ADP crystals. This greatly contributed to ASW technology. He founded the Massa Laboratories in 1945, which is now Massa Div., Dynamics Corp. of America. Frank is a fellow of both Acoustical Society of America and I.E.E.E.

Harold E. (Hal) Edgerton was honored by the German Society for Photography at its 30th anniversary Congress in Cologne May 7. Hal received an optical lens mounted in a gold setting and a citation honoring him for his development of stroboscopic photography.

From a belated notice from his widow, Ruth Willink, we report the death of **Arthur Willink** of Greenfield Center, N.Y., on Oct. 18, 1980. He was a graduate student in mechanical engineering. . . . **Henry C. Fowler, Jr.,** of South Yarmouth, Mass., died on Jan. 31, 1981. First employed with Fairchild Aircraft, he went with Chance Vought Aircraft, East Hartford, Conn., as an assistant plant manager. During World War II he worked for Colt's Patent Firearms as assistant engineer in charge of production. In 1948, he moved to Pratt & Whitney Aircraft as production engineer until his retirement in 1966. Larry became a permanent member of the Cape Cod Division of the Coast Guard Auxilliary. We extend our sympathy to his widow, Celia, and hope she will come to our reunion.

You will be receiving a letter from our reunion chairman, **Ray Hibbert,** in September stating the plans for our 55th in June '82. A postcard will be enclosed to be returned with your intentions. We hope you and your spouses are planning to come to enjoy meeting your classmates.—**Joseph C. Burley,** Secretary Pro tem, 5 Hutchinson St., Milton, MA 02187

28

Bob Proctor heard that a history of Course X had been written and was afraid his copy of the book might go astray since he was only recently moved to his new address. This prompted him to write a letter to **Jim Donovan** with verification of the new address in Huntington, W. Vir. Bob and Peg are enjoying the milder weather conditions at their new location and are pleased to be nearer their children's families, but do miss their old neighborhood friends. The book referred to, *The Improbable Achievement: Chemical Engineering at M.I.T.,* was written by Harold C. Weber, '18, M.I.T. professor emeritus and the only surviving member of the department's professorial staff as we knew it. Jim had a strong hand in seeing that the book was published and distributed. . . . From **Walter Mattlage** we have a brief note with a pat on the back for Jim and his constant efforts on behalf of M.I.T. Thanks for saying it, Matt, and we all agree!

Herb Dayton says things are booming in Houston. He expresses no complaint so we must assume that all is well with him. . . . **Bob Hennes** writes only that he retired in 1973 as professor emeritus, University of Washington. . . . Two photographs

clipped from the *Ravalli Republic* (Hamilton, Mont.) of February 27, 1981, show Mary and **Max Parshall** as one of the organizing couples for the area's Hospital Guild Ball. Max looks well pleased and a candid shot of Mary dancing suggests that she still has lots of zip.

A luncheon for senior alumni (1917-1928) was held on a beautiful Sunday last May 24 at M.I.T.'s Endicott House. At that time of year the setting is especially magnificent. Our class made a very good showing with these classmates and spouses in attendance: Rose and **Maury Beren, Hugh Bean,** Frannie and **Jim Donovan,** Dorothy and **Gus Rogowski,** Florence and **Walter Smith.** We heard a very informative talk (on his favorite subject) by Prof. Samuel A. Goldblith, '40, M.I.T. vice-president for resource development.

With deep regret we must now report the deaths of five classmates. **Martin W. Bardwell** died on December 13, 1980; the information was provided by his wife, Narcissa. Martin graduated in Course VI, electrical engineering. His entire professional career was with Mohawk Power Corp., Syracuse, N.Y., where he held various engineering and administrative positions. . . . **Carney Goldberg,** Course IV, architecture, died on May 2, 1981, at Beth Israel Hospital in Boston, Mass. Carney was a widely known, honored and highly regarded architect. He designed schools, public buildings, and many synagogues and temples in Massachusetts, including Temple Emeth where his funeral services were conducted. The class will especially feel his loss since he, with Dorothy, had undertaken the chairmanship for our approaching 55th Reunion. We are grateful that they had already laid the basic plan for us. The Goldbergs have a son and two grandchildren. . . . **Rogert E. Jenks** died February 21, 1981. Robert was a Course IV graduate student in our class and received his master's in architecture when we graduated. Our records show that his professional work was in architecture and that he had his own practice. . . . **George D. Mock,** Course IXB, general engineering, died in Sarasota, Fla. on April 28, 1981. In his first few years as an engineer, George worked consecutively for several companies then settled down to a lifetime career with the Washington (D.C.) Gas Light Co. He retired in 1972 as assistant to the president and director of corporate planning. Besides his wife, Laverne, he leaves a son and two grandchildren. . . . **Edward J. Poitras** died on May 13, 1981 at Vero Beach, Fla. Ed received both his degrees, S.B. and S.M., in Course VI-A, electrical engineering. He enjoyed a most successful and productive career as a development engineer, inventor and executive—mostly with Fenwal Incorp. (now a division of Walter Kidde & Co.). He is credited with about 65 patents. His many other activities included civic interests, hobbies, travel and sports—even late in life he was a tennis player to respect. Ed was a loyal member of the class and most generous in his support of the Institute. He leaves his wife, Dorothy (Pat), two sons, and six grandchildren.

To the families of all these classmates we extend our heartfelt sympathy.—**Walter J. Smith,** Secretary, 37 Dix Street, Winchester, MA 01890

29

For a number of years now, **Robert S. Pride** and his wife, Marion, of N. Palm Beach, Fla., have spent Easter with your secretary and his wife, Hellen, alternately in each other's houses for a family dinner. During the 1981 Florida Festival at Cypress Garden, which the Prides and Dinjians attended with a number of other 29ers, Bob reminded us that it was their turn to entertain us for Easter. A few days before, Bob sent us a reminder with a footnote: "Don't forget to wear a jacket and tie", which was a puzzle, as we'd always dressed informally in the past. Soon after we arrived at the Prides' home, we were informed that, unlike other years, this was going to be a special celebration—Bob's 74th birthday and their 51st wedding anniversary. After cocktails, Bob drove us to the Breakers Hotel in Palm Beach, one of the most elegant places to dine and dance. The food and service were fit for a king, and the occasion was well observed.

Richard E. Bolton of Montreal, Canada, writes, "Thank you for your kind message and birthday greetings. My wife and I have just returned from six weeks in the U.S., including a month on Sanibel Island, (Ft. Meyers, Fla.). It is a long drive, but a pleasant one. I still work a little—I am chairman of the Architectural Planning Commission, City of Westmount (population 25,000), probably the best-run small town in Canada. I have been retired from an active architectural practice, but I still do a little work on the side, mostly houses and restorations. My watercolor painting is not improving at a satisfactory rate, but I do have a collection of "Impressions" from North America, Britain, Southern Europe, Japan, and New Zealand. My oldest grandson, Brian Angus of Toronto, has made an application to enter M.I.T. and is presently visiting Boston for an interview at M.I.T. and Harvard. My son Richard A. Bolton is a nuclear fusion man who was lent to Princeton for a while. My health is ridiculously good for a man of 74 years old. Best regards to all." . . . **Anthony Standen** of S. Rent, Conn., is enjoying his retirement with his wife Lisl. they have two children and three grandchildren. Tony's hobbies are: attacking astrology and conserving energy. He has published a book, *Forget Your Sun Sign*, an outline of antiastrology. He was connected with Legacy Publishing Co. of Baton Rouge, La. . . . A brief note comes from **Adrian (Cub) Clark** of Woodbury, Conn., as follows: "At present, I do a little consulting work for a small manufacturer's shop, still sing in the church choir, and do community chores. I still play the violin and do volunteer work at the Bethlehem Elementary School, working with the ladies. I try to maintain a reasonable handicap at the Watertown Golf Club. I have finally come to the conclusion that the game should be played for fun and not be too critical and competitive." . . . **Hunter Rause** of Sun City, Ariz., writes: "Thanks for your birthday greetings, which are always welcome. Doi arranged to have our three children and three of our grandchildren here for my 75th birthday. In two weeks, I leave for another month of lectures and conferences in Peking. I'll send you a card. Our best to all." Hunter did send me a post card from China with a few lines: "Just a note to prove that I actually made it. This morning I gave a two-hour lecture to 70 engineers from all over the country. This place sure has changed since 1974." Hunter is a world-renowned expert in fluid mechanics, and his professional services have carried him to every continent except Antarctica. He has had technical missions to Egypt, U.S.S.R., Romania, Thailand, Venezuela, Japan, China, Taiwan, and Brazil. . . . A note comes from **Phil W. Sayles** of Lakeville, Conn., which says, "Just a brief note to tell you what 1981 means to our family: On October 1, I will have been retired for 10 years after 44 years of service with General Electric Co. On October 17, my wife and I will have been married for 50 years. I am feeling fine and our children and grandchildren are well, and they enrich our lives. Good luck to all."

Ruth Fahey, widow of **Jim Fahey** whose death was reported in the July issue of the *Review*, would like to inform Jim's many friends that in lieu of flowers, they can make contributions to the Alumni Fund in his memory to be used for scholarships. Those who wish to contribute may send their checks to: Dan Laing, president of Family Mutual Bank, Merrimack Street, Haverill, MA 11830. Such sums received will be kept in a 90-day savings account, and the proceeds will be presented by Ruth to the 55th Reunion gift. . . . A note from **Jonathan McCray** of Heber Springs, Ark., states, "I am saddened greatly at the news of Jim Fahey's death. Jim and I were roommates during our senior year at M.I.T., and we wrote our thesis together. So you can see that Jim was a good friend. Many thanks for letting me know so promptly. I appreciate this more than words can tell." . . . A somber note from **Clayton F. Jarvis** of Amesbury, Mass., states, "Open heart surgery at age 68, glaucoma, cataracts, loss of hearing and some arthritis have all taken their toll, leaving me with a bare existence. Before retirement, I was a construction engineer and have worked for most of the engineering firms in Boston such as Badger, Stone & Webster, Fay Spofford and Thorndike, Metcalf & Eddy, and Arthur D. Little Co. in Cambridge. My work has taken me to England, Laborador, Alaska, and most of the states in the U.S.A." Clayton spends winter months in Sarasota, Fla., and the rest of the time at 495 Main Street, Amesbury, MA 01913; phone (617) 388-6787. . . . A brief note from the widow of **Charles T. Allen** states that he passed away in February 1977. "I appreciated getting the greeting card, specially the lovely poem 'Salutation to Davin.' " The Alumni Office also informs me that **Harry A. Bloom** of Waltham, Mass., passed away on March 8, 1980.—**Karnig S. Dinjian,** Secretary, P.O. Box 83, Arlington, MA 02174

30

As previously reported in the notes, **Wes Wedemeyer,** after retiring from his St. Louis architectural firm of Wedemeyer-Cernick-Corrubia, Inc., joined the International Executive Service Corps, a volunteer organization that provides U.S. consultants to foreign companies. In 1978-79, Wes spent six months in Bucaramanga, Columbia, working with a developer on a shopping mall. More recently he spent three months in Buenos Aires consulting with a firm of architect-engineers and urban planners to develop a satellite city for 250,000 people outside Buenos Aires. While working on this project, he was the guest of honor at a dinner meeting of the M.I.T. Club of Buenos Aires. Wes's wife accompanies him on these consulting trips and is "a very valuable member of the team." When in the U.S., the Wedemeyers spend their winters in St. Louis and summers in Colorado Springs. . . . Since retiring as the planning director of Santa Barbara County, Calif., in 1969, **Dick Whitehead** has kept busy on a variety of volunteer jobs relating to the history of Santa Barbara. Thus, he is a director, past president, and past secretary of the Santa Barbara Trust for Historic Preservations, as well as a volunteer assistant to the director of the Santa Barbara Mission Archive-Library. Last year, he completed a master plan for the acquisition and development of the 200-year-old Santa Barbara Royal Presidio and helped in supervising the reconstruction of three of its rooms.

We have at hand notices concerning the deaths of five more of our classmates. **Ellsworth Wyman,** last November 5; **Wilfred Eaton** on December 9; **Clyde Tirrell** on February 10; **Henry (Pat) Pattison** on April 9; and **George Lawson** on April 22.

Unfortunately I have very little information at hand about Ellsworth Wyman. He entered M.I.T. as a sophmore from Hamilton College and apparently lived all his life in or near Little Falls, N.Y. The notice of his death was supplied by his executor and stepson, David Bone.

The news of Bill Eaton's death came via a note from **Hank Halberg** (written from Little Rock, Ark.), who had apparently received the news from Bill's wife, Linda. Bill worked at one time for Morrison-Knudsen in the New York area, and at the time he retired in 1976 was a project control engineer with Raymond International in Houston. After Bill retired, the Eatons moved to Corpus Christi for a while. Apparently, as of the date of his death, he was living in Tom's River, N.J. Bill was a colonel in the Army Reserve and was buried at Arlington with full military honors.

Clyde Tirrell worked for more than 30 years as a design engineer and section manager at the Naval Electronics Laboratory Center in San Diego, specializing in shipboard communications antennas and systems, primarily HF and UHF. He was active in local branches of I.E.E.E. and I.R.E. After his retirement from N.E.L.C., the Tirrells continued to live in San Diego until his death.

Pat Pattison had a long career in the advertising business, first with J. Walter Thompson and later with Benton & Bowles, from which he retired as chairman in 1969. After his retirement, he and Mary lived in Tucson, Ariz. About a year ago, Louise and I visited them and had an opportunity to see their lovely home, which is on a sizable plot of ground in the foothills of the Rincon Mountains northeast of Tucson. The house was exceptionally well-designed for retirement living with a roomful of amateur radio equipment, a well-equipped shop, a swimming pool, and a greenhouse in which Mary raised exotic

cacti. Pat had a very active retirement life, writing articles for QST and corresponding with other radio amateurs all over the world. Also, for a time he was a consultant to the director of research at the University of Arizona. In the 1960s, Pat made important contributions to the M.I.T. Alumni Center in New York, first as an organizer of the center and later as its chairman. The Pattisons have four sons, whose accomplishments were detailed in the October 1979 notes, and 10 grandchildren.

George Lawson worked for 38 years for G.T.E. Sylvania and its predecessors in the Boston area. He retired at the beginning of 1971 as vice-president and general manager, and he and Gerrie moved to Stuart, Fla., where they were living at the time of his death. They also had a summer home in Naples, Me. As many of you know, George and Gerrie were faithful "re-uners"; they attended all the reunions that I have attended and perhaps some others as well. George's memberships while living in Stuart included the M.I.T. Club of Palm Beach County and the Heritage Country Club of Hobe Sound. In addition to Gerrie, George is survived by two sons, a daughter, and four grandchildren. A third son, John, was a Marine Corps officer and died in Viet Nam.—**Gordon K. Lister,** Secretary, 294B Heritage Village, Southbury, CT 06488

31

OUR 50TH REUNION WAS A GRAND SUCCESS! **Dave Buchanan,** chairman of the Reunion Committee, and the members of the committee certainly selected an outstanding spot for the reunion at the Harbor View Hotel in Edgartown. Approximately 135 classmates and their wives, as well as a number of widows attended the Martha's Vineyard activities, and some 180 or so were at the Cambridge activities including Technology Day. The nominating committee, consisting of **Howard Richardson,** our prexy, **Ken Germeshausen** and **Gordon Brown,** chairman, made the following nominations: **Ken Germeshausen,** honorary president; **Howard Richardson**, president emeritus; **Dave Buchanan,** president; **Claude Machen,** vice-president and treasurer; and **Ed Worden,** secretary; **John Swanton,** assistant secretary; **Ben Steverman,** assistant secretary. Other nominations were called for and, there being no response, a motion was made and passed that the secretary cast a single ballot for the entire slate. The motion was carried unanimously.

Space and time do not permit a listing of the Reunion activities and those present, but if anyone wants this information, just drop a note to your secretary. During the class dinner a ham radiogram from **Fred Elser** was read congratulating the class on the 50th Reunion and mentioning that he was receiving his Ph.D. at the time of the Reunion. Classmates sent Fred their best wishes and congratulations on the Ph.D. at his age.

After all these years, it was a real pleasure to see **Charlie Wood,** who has turned out to be quite a photographer. . . . Peggy and **Bill Pitbladdo** were on hand. Bill retired from Rochester Telephone Corp. in 1970 as vice-president of engineering construction and has done consulting work regarding telephone central office switching equipment for Graybar Electric and Nippon Electric in Tokyo. He and Peggy have taken a number of tours to Europe, Hong Kong, Canada, and all around the U.S. In addition, Bill was a volunteer at the 1980 Winter Olympics in Lake Placid, N.Y., handling telephone traffic in the Olympic Village. He was also a volunteer at the 1980 U.S. Open at Oak Hill Country Club in Rochester handling telephone traffic. . . . **"Gabe" Gristofalo** retired from the Federal Aviation Agency in 1969, and now he and Rena spend seven months in Miami and five in New York every year. His first wife died in 1978; and he remarried in 1980. They took a six-week tour to Europe, and Gabe is now enjoying fishing and travel. . . . **Jack Allia** retired as corrosion engineer from New England Electric System and has since been active in the Retired Men's Club of Greendale in Worcester, Mass. This organization has weekly meetings with an average attendance of 480, has two golf leagues, four bowling leagues, and conducts many trips for its members. Jack and Sophie are planning a short trip each year to different sections of our country. . . . **Maury Ayers** likes fishing, is a lay minister of the Episcopal Church, a member of Rotary in New Brunswick, N.J., and has traveled to Mexico, Costa Roca, Jamaica, Kenya, Uganda, and France. Maury has three boys, 42, 38, and 24 years old.

It is with sorrow that we announce the death of **Robert W. Vose** on February 12, 1981. During his working years he was director of research at Chicopee Manufacturing Corp., director of development for Moore Co., chairman of the board of directors of Massachusetts Association of Conservation Commissions, and supervisor of Hampden Conservation District of Massachusetts. He leaves two sons and three grandchildren. Word has also been received of the death of **Clifford C. Walker** on March 25, 1981, and **Clifford M. Smith** on December 14, 1980. Our sincere condolences to their families. Hope to have more reunion news with the next class notes.—**Edwin S. Worden,** Secretary, P. O. Box 1241, Mount Dora, FL 32757; **Ben W. Steverman,** Assistant Secretary, 3 Pawtucket Rd., Plymouth, MA 02360; **John R. Swanton,** Secretary, 27 George St., Newton, MA 02158

32

I have received a rather disconcerting letter from **Juan Serrallach.** He writes from his hospital bed just before his heart operation—a bypass for a blocked artery. He hopes his doctor's optimism will be justified. He, therefore, plans to attend our 50th with his wife. He thinks of his classmates often and looks forward to the fun and pleasure of being with them next year. He extends an open invitation to all (10 at a time) to visit him at his wonderful home with swimming pool at Costa Brava. His address is: Pasaje Maluquer 11 Entlo, Barcelona 22, Spain. In behalf of the class, I wish you a speedy recovery.

Our president, **John Flatley,** tells me that **Ed Nealand** will be the chairman of our 50th Reunion Committee. In late May, when these notes were written, Ed said he was putting his committee together and planning a series of meetings to begin this June. Ed and his wife have moved to a condo in Sandwich. He spends about three months in Florida. He does some consulting work in Boston and is active in local civic affairs.

Virginia Vassalotti sends me the sad news that **Louis J. Vassalotti** died unexpectedly on April 30, 1981, at the Falmouth Hospital. Louis had an active life in the construction field—highways, bridges, housing developments, etc. He served with the U.S. Army Corps of Engineers during the war years. He was discharged in 1946 as a lieutenant corporal. He retired to Cape Cod in 1969. His wife says they had 11 beautiful years there. Louis leaves also one daughter and four grandchildren.

On May 11 I took part in a telethon for the Alumni Fund. I had the opportunity to talk with several of our classmates and obtained enough news for two or three issues of class notes. I was particularly pleased that I stimulated **Albert W. Dunning** to write the following letter: "Dear Melvin, thanks for your phone call—I have sent in my moderate contribution to the Alumni Fund today. Concerning activities since leaving M.I.T., I graduated as an ensign from Pensacola and was assigned to Fighter Squadron VF-1 flying off Saratoga. I continued flying for Monsanto for six years as their only pilot, but progressed in business to become vice-president and director for the company in Japan, Mitsubishi-Monsanto Chemical Co. I left to become vice-president of the Plastic Coating Corp. of Holyoke, Mass., then on my own formed Dunning Associates, Waquoit, Mass. I designed and built my own equipment to apply high-voltage electrostatics to powder coating for electrical insulation of small industrial parts—mostly gyro motors for the missile and space programs. Other activity included director, vice-president and president of the National Microfilm Association, which later grew to become the National Micrographics Association. Our family includes: son Ward—married, two children; daughter, Diane—married, two children; and Helen—married, two children. We moved here three years ago and love the Cape. We never got rich in money, but we are truly wealthy in family and friends."

The Alumni Records sends me the news that we have lost two of our classmates: **William C. Launder,** Belmont, Mass., died on January 3, 1981, and **Joseph Shilowitz,** Jersey City, N.J. died on March 1, 1979. I wish to express our class sympathy to the families. When I receive some obituary information I will be glad to pass it on. All for now.—**Melvin Castleman,** Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907.

33

As usual we have few contributions, though one of them is enough to cover three or more classes. **Bill Harper** wrote us five hand-printed pages, again mostly philosophical. One page gives me Bill's financial statement, and it is very orderly, and he concludes with the statement of his intention of giving a certain amount, arrived at by himself, mostly, but with the help of one capable Alumni Association fellow whose name is not familiar to me. In any event, Bill's intention is to give as generously as possible. He also comments briefly on comparison of tuition costs, 1933 and 1981. Golly, we don't seem to be using the same dollars. Somewhere along the line, our tuition went up $25 per semester, and I had to talk Del Rhind into giving me a full month to find the $25. Now look at it, or maybe no. My fervent wish is that many of us who are not able to join the big givers write the Alumni Fund office for advice on how to do our bit a little more easily. Those fellows have more tricks of finance for the little fellow than can be imagined.

Harper also asks what in the world is a sustaining fellow. Over a period of a year or more, this subject has been covered many times. But, briefly, the Institute says that a sustaining fellow is someone who has given M. I. T. $2000 a year, for a specified number of years, unrestricted. There are more of these than one might think, and the giver need not be an M. I. T. man or woman.

Cal Mohr comes through with a rather good bit for use here. First, Cal, you wish to know what **Otto Putnam** did with your list of plant visits long ago. I do remember printing something like this, but Otto is the fellow to talk to, or write. Only fault I find with Otto is that he is too dang good-looking. Cal, my letter to said Mrs. V. was returned to me because of lack of proper address. Cal says that he had a letter from **Doug Stewart** that he had been in and out of the hospital for over a year.

Further, we have another bit worthwhile. Cal says that **Dave Babcock** had a daughter graduating from M. I. T. in June. He wrote **Fred Murphy** suggesting that the Class of 1933 make some little fuss over the new alumna. Incidentally, Dave has another daughter two years younger than the one just graduated. The notable part of this is Dave is our age, but we have granddaughters of college age, so there! Many, many thanks, Cal, for such a fine, newsy letter. I am writing the news for this issue on May 22. Your further news will keep well until fall, maybe.

We have a timely card from **Fred Murphy** and his Anne, visiting Bermuda, as they have for many years at this time of year. It seems unnatural, but, they are enjoying the general strike being enjoyed there right now. . . . **Mal Mayer** sends a card from Trondheim, Norway, where "we are taking the mail boat trip up the coast of Norway, after a wet week in England." They will be home in Maine after the black flies leave. Mal and his wife are, by far, our most travelled classmates. Thanks for the cards, Fred and Mal. . . . Two classmates have passed on this spring: **Loren H. Nauss, Jr.,** 49 Daley Street, Bristol, Conn., and **Roger E. Greenwood,** 4745 91st St., E, Mercer Island, Wash. We have written to the two surviving widows. I have never asked before, but how nice and thoughtful it would be were a few of us to write these widows, and quickly.

That's it for now fellas and gals. Thanks for absorbing parts of this tome, and please drop me a short line, every dang one of you.—**Warren J. Henderson,** Secretary, Fort Rock Farm, Drawer H, Exeter, NH 03833

34

Let me begin with a few Alumni Fund notes, the first being from **Joe Dauber,** who writes, "I retired in 1978 as president of Gaertner Scientific Co., a Chicago manufacturer of optical measuring instruments. At present I am a consultant to Theomonetics Corp. of San Diego, which makes gradient layer colorimeters and heat flux transducers."

In about two steps above shorthand, **John Casey** managed to cover a 47-year career (just so far) on one of the fund sheets! Just read the following: "The Panama Canal, 1934-41; Jackson and Moreland, Boston, 1941-42; post engineer, Ledo, Assans, India, 1943-45; lecturer, electrical engineering departments, University of New Mexico and University of Kansas, 1945-46; professor of electrical and computer engineering and co-director of power systems laboratory, University of Michigan, 1946-72; professor emeritus and consulting engineer (large clientele), 1972 to date. Special work assignments with General Electric (three) and Commonwealth Associates, Jackson, Mich., 1939, '52, '55. United States A.I.D. India Power Systems, 1964." Obviously just a "job hopper." John then goes on, ". . . married Grace Jones in 1937 and have three children, six grandchildren. Registered professional engineer in Michigan Society of Professional Engineers (M.S.P.E.), 1965-66; national director of M.S.P.E., 1969-75. Author of several technical papers and one textbook. Received my master's of electrical engineering at M.I.T. in 1953. Principal home is in Ann Arbor, Mich., and my winter home is in Clearwater, Fla. Sixty-nine years old with no thoughts of retiring."

It all adds up to quite a career and an electrical interest in the engineering profession. For years I always felt almost embarrassed when I was around John. You'll remember that as freshmen we all had to take compulsory R.O.T.C. In anticipation of this, I had gone in the summer of 1930 to 30 days of C.M.T.C. By virtue of this vast experience, I ended up as first sergeant of one of the companies. John, with *four* years of R.O.T.C. at Boston Latin was a platoon sergeant in the same company! This must have irked his soul, but he never let it show. So I particularly enjoy reading of his successful career—especially when he's still around to write about it himself.

I received a brief release that **Harold E. Thayer** has resigned as chief executive officer of the Mallinckrodt Corp., in St. Louis. Harold will continue as chairman of the board.

Sorry to say, word came of the passing of one more of our classmates. On November 4, 1980, **James Wadhams** died in what was apparently his current home in Franklin, N.C. The information comes from his brother, to whom we express the sympathy of all our class.

A final item concerns one of our members who has gotten into somewhat unusual work. I received a note from **Lester Tarnopol,** who, after receiving his B.S. in Course VIII with our class, stayed at M.I.T. for an M.S. and then went on to Harvard where he was awarded a Sc.D. in 1938. He retired three years ago from the City College of San Francisco, where he taught engineering, mathematics, and psychology for 31 years, to have more time for research and publications, of which he has about 70. Dr. Tarnopol has apparently specialized in the field of learning difficulties. This year he has published three books, one in English, one in German, and one in Spanish (or possibly, Portuguese). The one in English is entitled *Comparative Reading and Learning Difficulties.* At the time he wrote, he was about to leave for a couple of months abroad and will attend, as one of 40 invited speakers, an international seminar on children with special learning problems at the University of Southampton, England. Since Dr. Tarnopol mentioned he would be glad to hear from classmates, his address is: 769 Edgewood Rd., San Mateo, CA 94402.—**Robert M. Franklin,** Secretary, 620 Satucket Rd. (P.O. Box 1147), Brewster, MA 02631); **George G. Bull,** Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD

35

Miller A. Wachs sent a note through the Alumni Fund Office: "Engineering consultant on Piasecki Aircraft's Helistat, a hybrid heavy-lift aircraft consisting of a blimp plus four helicopters." . . . **Goffe Benson** just returned from a trip to China, to his home in Pound Ridge, N.Y.

The 21st year for our class golf tournament was underway when these notes were prepared in late May, with 28 hopefuls. **Dick Shaw** was the defending champion. We welcome **Hank Ogorzaly** and **Chet Bond** to the tournament this year. Several of the golfers have returned north from Florida winters including: **Leo Beckwith, Bob Flood, Al MacAdam, Al Johnson, Chet Bond** and **Sid Grazi** (from LaCosta, Calif., to Denver).

Bill Cross reports he has become interested in ham radio and spent a month in the Barbadoes operating from there on 8P6NW. His son Peter was there part time operating in the International DXCC Contest. . . . **John Taplin,** chairman of the 50th Reunion Gift Committee, had his first meeting May 29 with the following members in attendance: **Bissell Alderman, Randy Antonsen, Leo Beckwith, Ben Blocker, Nix Dangel, Allan Mowatt, Frank Sellew** and **Dave Terwilliger,** along with Alumni Fund staffers. You will be hearing more about this committee in these notes as well as from committee members themselves during the next four years. . . . Sarah and **Phoenix Dangel,** Polly and **Wes Loomis,** Jane and **Pete Grant,** and Marion and **Lester Lappin** were the '35ers who attended the Annual Spring Picnic of the M.I.T. Club of Southwest Florida on March 29. They very obviously enjoyed themselves.

I am sorry to report the death of **Ernest E. Van Ham** on February 14 in Lyndeboro, N.H. Ernie had lived there for the past 24 years, 20 of them while he worked for Sanders Associates in Nashua. . . . I am also sorry to report the death of **Helen Sullivan** (Mrs. Eugene) on February 22 in Arlington, Mass. She received her master's degree with our class.

I hope you are enjoying a fine summer.—**Allan Q. Mowatt,** Secretary, 61 Beaumont Ave., Newtonville, MA 02160

36

Post Reunion Update. Fifty classmates attended our 45th Reunion. They were Rilla and **Walt MacAdam,** Astrid and **Stan Johnson,** Dorothy and **Ed Halfmann,** Martha and **Bill Fingerle,** Betsy and **Harry Essley,** Betty and **Art Sarvis,** Vivienne and **Eli Grossman,** Virginia and **Dick Denton,** Mary and **Bill Mullen,** Ruth and **Hank Lippitt,** Jean and **Pete Weinert,** Marian and **Pat Patterson,** Jan and **Bob Gillette, Leo Kramer,** Barbara and **El Koontz, Frank Parker,** Gloria and **Andy Brisse,** Jeanne and **John Myers,** Virginia and **Augie Mackro,** Pauline and **Ken Arnold,** Janet and **Russ Miller,** Avis and **Ariel Thomas,** Bernadette and **Roman Ortynsky,** Virginia and **Dick Fox,** Natalie and **Henry Runkel,** Peg and **Fletch Thornton,** Louise and **Clancy Horton,** Rose and **Ed Dashefsky,** Margaret and **Charles Price,** Alba and **John Viola,** Dottie and **Tony Hittl,** Phoebe and **Frank Phillips,** Lillian and **Larry Peterson,** Mary and **Fred Assmann,** Edith and **Mike Tremaglio, Dick DeWolfe,** Margaret and **Dorian Shainin,** Rosalie and **John Chapper,** Betty and **Elliott Robinson,** Peg and **Laddy Reday,** Harriet and **Dana Devereux, Brent Lowe,** Catherine and **Gerald McMahon,** Anne and **James Baker,** Dorothy and **Henry Johnson, Slim Beckwith,** Helene and **Oliver Angevine,** Roberta and **Tom Matthews, Fred House** and your secretary. The Mackros toured China with the "M.I.T. Visit China" Group, and Laddy Reday was recently camping and hiking (again) in the Australian Outback.

Ten others put in appearances either on campus and/or at the Wychmere Harbor Club. They were: Kitty and **Herb Borden, Robert Caldwell,** Florence and **Ben Cooperstein,** Mildred and **Martin Gilman, Dick Halloran, Chuck Kennedy, Henry McGrath,** the **Hamilton Migels, Mac Nyhen,** and **Milner Wallace. Bernard Birdsall** and **Herb Metten** were on the list at the registration desk in Kresge but no one to whom I spoke had seen either of them.

At the class meeting the following were elected: president, **Tony Hittl;** vice-president, **Fletcher Thornton;** secretary, **Alice Kimball,** and treasurer, **Eli Grossman.** Your secretary has been prevailed upon to serve as 50th Reunion Chair, with promises of substantial assistance from everyone!

Mini-reunion Announcement. There will be a mini-reunion on Saturday, October 24, in West Hartland. My responsibility consists of opening the door and getting out the coffee pot. If you are interested in attending this function, contact Virginia and **Augie Mackro** at 139 Pepper St., Monroe, CT 06468, (203) 268-0116.

I regret to report the deaths of three classmates: **James W. Vanderpool,** on November 20, 1980, of 4706 Massingale Rd., Tucson, AZ 85704. He formerly lived in Lewiston, Maine. **John J. Hanagan,** died April 19, 1978. His widow, Meta lives at 1844 Restful Drive, Bradenton, FL 33507. **John R. Muma** died on February 17, 1981 following an automobile accident. He was the owner of the Punch Bowl Nursery in Northport, Long Island. He is survived by his wife, Edith, a daughter and a sister. His address was 6 Callahan Road, Northport, NY 11768. I am sorry to have to end on such a sad note.—**Alice H. Kimball,** Secretary, P.O. Box 31, West Hartland, CT 06091

37

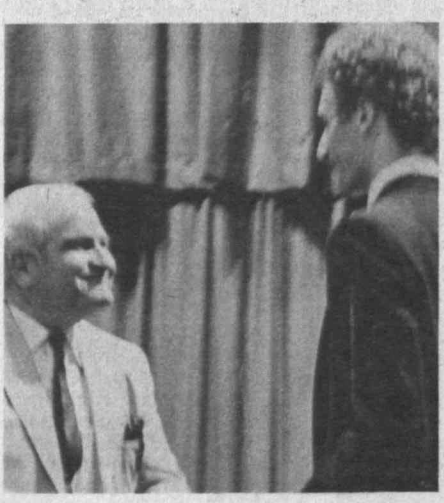
Robert C. Glancy wrote in December as follows: "Following a two-week visit to England and Scotland, I retired from AT&T Long Lines in July 1980 after 43 years. Carrie and I enjoyed the summer at our New Hampshire cottage, had two weeks at St. Petersburg, Fla., over Thanksgiving, and are now enjoying the holidays with our oldest daughter, Carol, who is a major in the Air Force at Scott AFB. Following this, we returned to White Plains, N.Y., and must settle down and really be retired." . . . **Paul W. Allen** of 1175 Glen Oaks Blvd., Pasadena, Calif., retired as a mining consultant on March 1, 1980. He is a member of the California Annandale Golf Club and the N.Y. Mining Club. His wife's main interest is the Gamble House Museum of Pasadena. His son Laurence, 36, is married, and his son Clifton, 29, is not. Paul's interests and hobbies are skiing (both cross-country and downhill), rock climbing, trekking (Nepal, China), and tennis.

It is with regret that I report the passing of two of our classmates: **Joseph Puffer,** 9 Ravine Rd., Winchester, Mass., died November 27, 1980, and **Flora Crockett Stephenson** died February 10, 1979. Her husband, Gordon Stephenson, wrote, "My wife earned a Bachelor of Architecture in city planning and was probably the first woman with the M.C.P. She completed her thesis in the first week of the war. My wife was Flora Bartlett Crockett. Her mother's and father's families were in Maine before the Revolution. She was born in Westwood, N.J., and for six years as an M.I.T. student she lived in Boston. She worked with me in England, 1938-53; Australia, 1953-1955; Canada 1955-60; and Australia, 1960 until her death on February 10, 1979. My wife was joint author of two books and worked with me on a series of published studies and reports."—**Lester M. Klashman,** Assistant Secretary, 198 Maple St., Malden, MA 02148; **Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford, MA. 02155

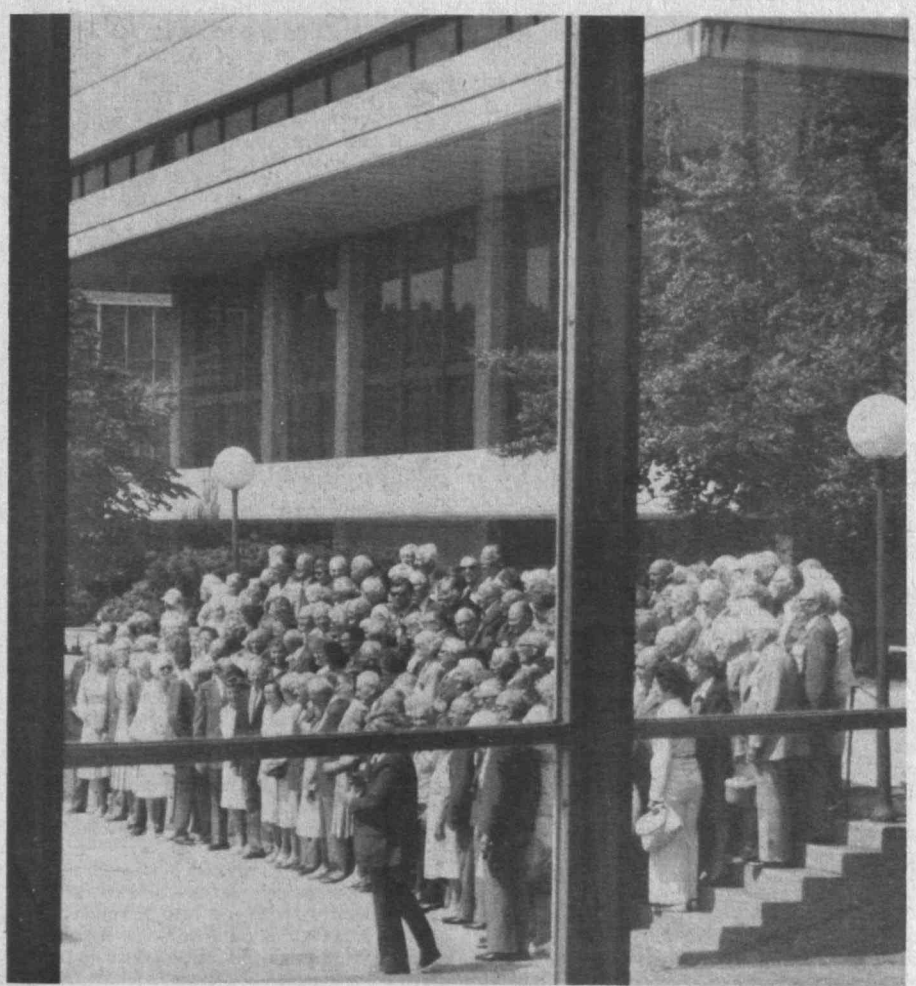
38

In my May/June notes, I mentioned very modestly that Chatham, Mass., has become the retirement haven for 1938, boasting three of us. **Ed Hadley,** who was the editor of what he calls the "definitive work on the illustrious class of 1938," has protested, since his 1978 masterwork showed 26 cities with three or more 38ers. Like most mechanical engineers, Ed showed an abysmal lack of imagination, since his statistics were before retirement. The challenge is extended: Does your town boast more than three retired 1938ers?

Despite the date, this is written before our class dinner at Endicot House on June 5. However, con-



In ten minutes at the Technology Day luncheon on June 5, four alumni listed gifts of over $5.1 million for M.I.T. Reporting for their classes were Kenneth J. Germeshausen, '31 (top), $3.137 million; Frank S. Wyle, '41 (far right), $1.362 million; Roger S. Borovoy, '56 (above), $600,500; and Mitchell Brook, '81 (right), $2,230. Paul E. Gray, '54, beaming, said he could think of "no better capstone" to his first year as president of M.I.T. than this new evidence of "the spirit of generosity which has marked alumni giving to the Institute over the years." (Photos: Calvin Campbell)



On hand for their 30th Reunion celebration in June, members of the Gray Beavers Athletic Club and Sporting Society, Inc. (above) work out on the Charles River. From left: Sara Henderson, '83 (coxswain), Allen B. Fonda, Forest C. Monkman, Paul G. Smith, Roger L. Schonewald, George W. Merrow, George C. Underwood, William P. Reynolds, and Arthur H. (Spider) Schein. (Photo: Ken Cerino, M.I.T. sports information director)

Members of the Class of '31 (left) pose for a class picture beside Stratton Student Center. "Our 50th Reunion was a grand success," says Ed Worden, class secretary.

Above: Head table at the Class of '21 M.I.T. Museum dinner.

versations with **Dave Wadleigh** and **Ed True** confirm a sell-out, and, fie on you who didn't come. Next year, maybe?

Walt Johnson wrote to say that he has retired and is spending 180 days in Shrewsbury, escaping from Taxachusetts in the winter to Fort Myers. Walt recently recovered from an aorta bypass. . . . At least one member of the class does not plan to retire. I received a press release on the 25th anniversary celebration of **Richard Muther** and Associates, Inc. Dick, 25 years is not a milestone. Remember our 25th reunion?

One of the problems of being a class secretary is inadequate communications, an area that each of you can improve by dropping me a note, the foregoing by way of explanation for late reporting on the death of **John Phinney** from a massive coronary on December 16, 1979, and **Francis Ford** on November 4, 1980, cause unknown.—**Armand L. Bruneau,** Jr., Secretary, 663 Riverview Drive, Chatham, MA 02633

39

John Herlihy headed the department of industrial engineering and retired after a lifetime career with Inland Steel Co. of Chicago. John served as president of the Chicago chapter of the American Institute of Industrial Engineers, and he is a decorated veteran of the U.S. Army Air Corps, where he served during World War II.

Jim Barton relays news from Seattle that the **John Alexanders** are about to return to Seattle from their South Sea sailing adventures. John can reminisce in his retirement about his career, which included playing the tuba, singing in barbershop quartets, pioneering for Boeing in jet aircraft, and sailing the Pacific for several years in his 38-footer.—**Hal Seykota,** Secretary, 1421 Calle Altura, La Jolla, CA 92037

42

Dick Gibson is having a very enjoyable and busy "retirement." He is still serving on the Air Force Scientific Advisory Board and enjoying the lack of daily deadlines which he describes as "a great boon to the quality of life!" The Gibsons are heating their farm with wood and very little oil, and found their first Maine winter to be surprisingly tolerable and neatly balanced by the superb summer sailing. . . . **Don Stein,** director of ship concepts/development division of the Military Sea Lift Command is working on our rapid deployment force and taking time out to enjoy his new role as grandpa to his son's son. . . . Received a very fancy brochure from the Committee for Corporate Support of Private Universities. **Ed Vetter** is on its gold-plated list of members, still active in good causes.

Hugh Schwartz, our Southern regional vice-president, has been appointed chairman of the M.I.T. Alumni Association's Awards Committee. You all will be hearing from Hugh and from our other regional vice-presidents about the "across-the-board" solicitation for our 40th Reunion gift. As you all know, a lot of dollars are already in and pledged due to the effective and hard work of **Floyd Lyon** and his committee. But we want to see maximum individual participation, and this is the part of the class gift program planned through the regional vice-presidents.

Bob Howard and **Carl Zeiss,** our reunion co-chairmen, are making their plans and you will be hearing from them soon.

News is getting kind of scarce (this is being dictated in May). We are out of the "backlog" so let's hear from you-all. Very best wishes for a happy, healthy and enjoyable summer.—**Ken Rosett,** Secretary, 191 Albermarle Road, White Plains, NY 10605

43

Congratulations to **Bernie Brindis** on the arrival of his second grandson. The proud father is Dr. Ralph Brindis, '71, of San Francisco. I would hate to have Bernie's commuting bill from North Brunswick, N.J.

One of those intimidating announcements (FOR IMMEDIATE RELEASE!) from a New York public relations firm tells us that **Warren Fuchs,** Course X, has joined the Heyward-Robinson Co., Inc., as manager of synfuels in the commercial development department. Heyward-Robinson is a large, international design-construction firm serving the process industries. Warren has more than 30 years of experience in the chemical process business, and the photo supplied with the press release stares out with an appropriately stern expression, softened by a slight twinkle. Sorry, Warren, but the word "immediate" is unknown in the *Review* publication schedule.

Hearty greetings to all you classmates. Please send in some news, or I shall be reduced to filling this space with stories about myself. Heaven forbid!—**Bob Rorschach,** Secretary, 2544 S. Norfolk, Tulsa, OK 74114

44

As these class notes are being written, the official start of summer is still a few weeks away. As you read these notes, the start of the school year is a few weeks away. For many of us, Labor Day heralds the end of summer with its light-hearted ways and a return to a more serious way of life and getting involved again in many activities

I hope that now that we are starting a "new" year, you will find the time to send news of yourself to your class secretary. The last packet from M.I.T. was void of news.

Fifty years ago, at a time when most of us were in grade school, coeds who had transferred to M.I.T. from women's colleges such as Smith, Wellesley, and Radcliffe said in interviews that they found M.I.T. work no more difficult than that at their former colleges. They did not mind the long class hours. They did feel that classes often attempted to cover too much material in too little time. They also said that students acquire techniques for solving problems, but no real grasp of the subject. (How fortunate for us that things had improved by the time we arrived at M.I.T. At least we learned how to approach problems and how to solve them.)

I'm waiting to hear from *you.*—**Melissa Teixeira,** Secretary, 92 Webster Park, West Newton, MA 02165

46

There is not much to report this month. Mary and I leave for the 35th Reunion tomorrow and we hope to obtain lots of material for future issues of the Class Notes. **Marshall Tulin** wrote a letter to **Jim Goldstein** on March 26, 1981, which I am pleased to share with you. Marshall was hoping at that time he could attend the reunion, but he had a conflict with the dates, which he hoped he could resolve so he could attend. Marshall is still absorbed with the hydronautics business in his position at Hydronautics, Inc., of Laurel Md. Immediately after writing the letter, Marshall was off to China and Japan on a lecture tour that would be completed on May 18. Marshall goes to Tech periodically to lecture and was elected to the N.A.E. in 1979. . . .Jim Goldstein received a nice letter from **Bob Goodstein,** which I am pleased to share. Bob is with Boeing on the West Coast, working on guidance navigation and control systems for aerospace vehicles. Bob occasionally has been back to the Draper Labs. Bob has also enjoyed other interesting travels. His wife, after raising three boys, has a business of running duplicate bridge games and because of this has been hired as a bridge lecturer on the *Love Boat* for a few weeks a year. She takes him to Alaska, Mexico, and the Caribbean, if he carries her bridge supplies. . . .**William A. Hanpeter** is a manufacturers' representative in St.Louis. . . .**Ned A. Spencer** is with the Mitre Corp. in McLean, Vir.

Hillman Dickinson has reported the tragic death of **Walter R. Milliken** while on active duty with the Air Force last year. Mr. Milliken was crushed by a tree felled by lightning while trying to get others to safety.

Until next time.—**Russell K. Dostal,** Secretary, 18837 Palm Circle, Cleveland, OH 44126

49

Francis M. Bator is professor of political economy at Harvard. In a long, special essay in the British weekly *The Economist,* he claims wages are a major factor in maintaining high inflation. Unless the Reagan administration institutes some form of wage control, Francis warns that the inflation rate is likely to be as high as 15 percent by the end of 1984. Other forms of inflation control—increased productivity boosting investment, supply-side economic steps, and tax reductions without spending cuts—are too slow and too vulnerable to economic jolts like an OPEC increase. He recommends "imposing a surtax on the profits of employers who give raises that exceed a specified national norm. There is no tolerable alternative." . . . **William Stein** is spending a year in Ireland setting up a new plant. . . . **Leonard Newton** was sent to Peking in 1945 as one of 10 Air Force officers assigned to oversee the transfer of power from the Japanese to the Americans. This summer Len retraces this journey. He and Ruby will lead a group of our alumni to Peking, Shanghai, Sian, Kweilin, Kwangchow, and Hong Kong. "Our trip is remarkable because we will be greeted and shown around by Chinese who graduated from M.I.T before the war." Len and Ruby will celebrate their silver wedding anniversary while in Hawaii. Len is a consultant in communications and energy, following 25 years with Opinion Research Corp. and response analysis.

While attending my first meeting of the M.I.T. Club of St. Louis, I was pleasantly surprised to meet two classmates, **William E. Dennis** and **George Jacobson.** These two '49ers have followed similar paths through their careers. Both graduated from the Coast Guard Academy. Bill Dennis came to M.I.T. during the war, George went to sea. They both met again when George entered M.I.T. after the war ended. George graduated in January 1949, and Bill got his advanced degree in June. Bill stayed in the Coast Guard, retired from his St. Louis post, and now works for St. Louis Ship, a division of Pott Industries. After graduation, George came to St. Louis, and is now president of Universal Carriers, Inc.

It's been nice to talk with you again. Please keep *your* news coming to me so I can share it with our friends.—**Paul E. Weamer,** Secretary, Cambridge Engineering, Box 1010, Chesterfield, MO 63017

50

On April 4, 1981, **Edward L. Friedman** was installed as commander of the New Britain Power Squadron. N.B.P.S. is a unit of U.S. Power Squadrons, an organization of boatmen involved with educational, fraternal and civic service.

We received a couple of replies for **Ed Kruse,** who was inquiring as to whether any class members have governmental elective offices or appointments. **Chester E. Claff** sends greetings to Ed, whom he remembers as one of the most jovial of the "Laughing Boys" of Baker House, a group to which he is honored to have belonged. Chet and his wife are members of the Brockton (Mass.) Republican city committee and were delegates to the state Republican convention in 1978. Chet is also a congressional science counselor for the American Chemical Society to his congressional representative. He has never run for, or been elected to, any public office. Chet also says, for the record, a devious career has led him to become a free-lance technical translator, which he finds to be a most satisfying and challenging field, and he would be interested in knowing if any of his classmates are doing anything similar.

We also heard from **Norman B. Champ, Jr.,** who was a Democratic delegate for Carter in 1976 and attended both the 1972 and 1980 Democratic conventions as V.I.P. ("fat cat"). He ran for state representative in 1972 and lost, but was elected Democratic committeeman in a close race in 1976 and

was reelected in 1980 (no opposition). He also is Democratic chairman, Second Congressional District of Missouri. He served on Committee for Preservation of White House from 1977-1981 and is in the middle of a six-year, Senate-approved term as a member of National Council on the Arts, which is the policy board for national endowments. Norman says this has really been fun and would hope that more of our classmates are also involved.

Dr. **Jordan Loftus,** staff engineer in the engineering department of Texaco, Inc., Houston, Tex., was recently elected chairman of the American Flame Research Committee. The committee currently consists of 41 industrial organizations in the fields of petroleum, petrochemicals, steel, glass, power, aluminum, and related industries. Individual academicians from M.I.T., Ohio State, Purdue, University of Arizona and Queens University of Ontario, all major centers of combustion studies in North America, serve as associate members. This is one of the nine national committees of the International Flame Research Foundation, headquartered in Ijmuiden in The Netherlands where its research station is located. The American Flame Research Committee was founded in 1955 by M.I.T. professor Hoyt C. Hottel, who served as chairman during its formative years. Dr. Loftus is the third chairman of the committee. After working in industry as pilot plant manager and then chief process engineer at the shale oil division of Petroleo Brasileiro (Petrobras), Sao Paulo State, Brazil, from 1954 to 1958, he returned to the U.S. He received a doctor of science degree in chemical engineering from M.I.T. in 1963 and joined Texaco that same year. The Loftus's have three children.

Daniel G. Fawcett addressed the University of Illinois A.I.A.A. on electronic warfare in March. He was nominated secretary of Old Crows' Mission Roost in Orange County. Dan and his wife, Nancy, have a daughter, Sara, who graduated from Katharine Gibbs in Boston in June. They visited their son, Dean, in Armor, Germany, in October.

In February, an exhibit and gallery talk on antique maps was the highlight of the open house of the Greater Boston Chapter of the National Association for Armenian Studies and Research at the N.A.A.S.R. headquarters and center in Cambridge, Mass. The exhibit consisted of maps from the collection of **Armen John Esserian,** of Cohasset, a collector of antique maps with particular reference to Armenia. He became involved in this fascinating and meaningful hobby as an outgrowth of his interest in geography. Armen is now director of the Itek Corporation of Lexington.

In updating our records we were saddened to learn of the death of **Hans F. Eckardt,** who passed away on December 10, 1980.—**John T. McKenna, Jr.** Secretary, 1 Emerson Place, Boston, MA 02114

52

Professor **Dana W. Mayo,** has been appointed chairman of the chemistry department for the next three academic years at Bowdoin College, Brunswick, Me. Dana also holds the Bowdoin chair of Charles Weston Pickard Professor of Chemistry and has been a member of the faculty of Bowdoin since 1962. . . . **Milton S. Dietz,** formerly vice-president, engineering, at Polaroid Corp., has been named to the new post of senior vice-president, engineering. . . . **John S. Rydz** has been named director of productivity for Emhart Corp. in Farmington, Conn. John was formerly vice-president of the sewing products group, the Singer Co., and director of its corporate office of innovation. He was responsible for the total technical redesign of the electronic sewing machine, which was said by Singer to be the most fundamental change in more than 100 years of sewing machine history. Prior to his experience at Singer, John had been vice-president at Diebold, where he was instrumental in the development of electronic banking systems and computerized security and protection equipment. In his new position, John will be responsible for creating and implementing technological developments designed to produce major manufacturing productivity gains. Emphasis will be on microelectronics.

Alwyn C. Scott, a professor of electrical and computer engineering at the University of Wisconsin, has been appointed chairman of the Center for Nonlinear Studies at the Los Alamos National Laboratory. The announcement was made April 3 by Laboratory Director Donald M. Kerr. Dr. Scott's research interests lie in the theory of nonlinear wave propagation and its applications. Much of his work has been theoretical, with the goal of bringing theory and experiment closer together in applied science. On the experimental side, he has devoted most of the past year to experimental electrophysiology. He is currently researching the propagation of biological energy along alpha-helix proteins by solitons. Dr. Scott also holds a National Science Foundation grant through 1981 for non-linear wave studies. He has lectured extensively in Italy, Austria, Canada, Denmark, and the Soviet Union, and has been guest or visiting professor at the University of Bern (Switzerland), Tohoku University (Japan), and the Technical University of Denmark.

William Quigley died suddenly of a heart attack early in March. Dr. Quigley, who obtained a bachelor's degree in physics from M.I.T., served two years in the army and then entered Boston University Medical School, from which he graduated in 1962. He practiced in Worcester, Auburn and Whitinsville, Mass., and studied at Rhode Island Hospital in Providence before moving to Cambridge, Ohio, in 1974. Dr. Quigley was a radiologist who was active in the field of nuclear medicine, with particular emphasis in nuclear cardiology. Most recently, he practiced at Guernsey Memorial Hospital in Cambridge, Ohio. He leaves his wife, Imelda; a son, Brian, and a daughter, Janice, of Cambridge, Ohio. . . . On May 8, 1980, **Joseph F. Kotrich, Jr.** passed away in Cincinnati, Ohio. Joe obtained a bachelor's degree in electrical engineering from M.I.T. and was a production consultant with E. Kahns Sons Co. in Cincinnati.—**Arthur S. Turner,** Secretary, 175 Lowell Street, Carlisle, MA 01741; **Richard F. Lacey,** Assistant Secretary, 2340 Cowper Street, Palo Alto, CA 94301

54

The Boston area, as well as well as the rest of New England, is now in the midst of a siege by gypsy moths. Their larvae start out as tiny, almost invisible (especially at our age) black caterpillars about one-quarter inch long. They arrive almost magically, borne by winds, to nestle on the newly formed leaves of trees. Numerous tiny holes in the leaves are the first indication that the little beasties are around. Within two to three weeks, many of the leaves will entirely disappear—replaced by large, thick, juicy caterpillars looking for a safe place to spin a cocoon, from which they will later emerge as brown moths. The Bay State has recently adopted a new advertising slogan, and from all indications it appears that this year the gypsy moths are "Making it in Massachusetts."

On the brighter side, I am pleased to advise that **Francis W. Ahearn** has been named executive vice-president of Manganaro Brothers, Inc., of Malden, Mass. . . .Also, **John E. Preschlack,** president and chief executive officer of the General Binding Corp., has been elected a director of the Maytag Co. He is also a director of House of Vision, Little Rapids Corp., and Hycor Corp. Congratulations and best wishes to the two of them!

Finally, I am sorry to report the death of **Emanuel S. Pazar** who died on August 24, 1979. Our condolences go to his widow, who lives at 37 Tanager St., Arlington, MA 02174.—**William Combs,** 120 West Newton St., Boston, MA 02118; **John Kiley,** 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney,** 52 Symor Drive, Convent Station, NJ 07961; **Dominick A. Sama,** 28 Chestnut Hill Rd., Groton, MA 01450

56

We go to press just before the Great Comeback weekend; so watch this space next issue for a full report! Early registrations suggest a spectacular event.

A few news items include notice of **Stan Wray's** photo in an Aerospace Corp. recruiting ad, mentioning that he's an engineering specialist in the project management applications office in El Segundo, Calif. . . . Dr. **Ward Halverson** is working on what sounds like a *Star Wars* simulation of spacecraft operations at the Spire Corp. in Bedford, Mass. . . . **Bill Leitch** organized a conference on "Srategies for Office Systems" for the International Data Corp.'s spring executive conference last February at Boca Raton. . . . **Vic Bauer** is executive vice-president of Hoechst-Roussel Pharmaceuticals in Somerville, N.J. Vic did his Ph.D. in chemistry at Harvard and was with Lederle Labs until 1971. He and Sonja have a son at Rice, and an older daughter. . . . **George Brown** has started his own Brown Engineering firm in Downers Grove, Ill., after 20 years with Turner Construction. He reports the expected problems of a small business start up, but feels a big relief from the travels involved in the big project construction business.

Ed Konik has been with Dynamics Research in Burlington, Mass., since 1968, and with Sperry before that. He's involved with engineering consulting and has two daughters in high school. . . . **John Cronin** is now 14 years with Pfizer in New York City, currently as assistant to the president, involved with their agricultural genetics business. He and Lois have settled in John's hometown, Scarsdale, and have three children. . . . **Richard Kelly** has been elected a vice-president of Stone & Webster Engineering in Boston. . . . **Fred Bialek,** a founder and vice-president of National Semiconductor, has left to found Dorado Micro Systems of Cupertino, Calif.—in which he is reported to have a substantial financial interest. . . . **Peter Dulchinos** is very active in the town affairs of Chelmsford, and is operations manager of the tactical software development facility of the Patriot Weapons Control Project fot Harris Computers. He and Thalia have two sons.

More next month, and with fresh pictures.—Co-secretaries: **Warren G. Briggs,** 33 Bancroft Rd., Wellesly Hills, MA 02181 and **Bruce Bredehoft.** 7100 Lanham Ln., Edina, MN 55435

57

It is said: "Absence makes the heart grow fonder." Our version reads: "Absence makes deadlines easier to miss!" Here we go with all the news that's fit to print . . . and some that ain't. Data General Corp., of Westboro, Me., has announced the establishment of new business divisions, and **Michael Schneider** has been appointed head of the technical products division. . . . From Burr Ridge, Ill., comes the news that **Gerald L. Murphy II** is the manager, agri-business, science and technology, International Harvester Co. . . . **Robert Holton** writes of his involvement as vice-president, manufacturing, at American Synthetic Rubber Corp.; the job includes all technical, manufacturing and engineering activities, including the rehabilitation of a 38-year old, World War I rubber plant. . . . Dr. **Donald Arnush** is manager of the plasma physics department and of the fusion technology business area of TRW in Redondo Beach, Calif. He is living in Rancho Palos Verdes with his wife and two children. . . . A great note from **Barnard Silver:** "Climbed Mount Rainier after Mount St. Helens contributed most of her flank to our fair city of Moses Lake (hardest-hit community of its size). My new motto: 'Climb them while they're there.' Defeated in run for public utilities district commissioner in Grant County (third-largest in the country after New York and Los Angeles). Silver Energy Systems Corp. received the largest grant in the State of Washington from the small grants program of the Department of Energy: production of ethanol from Jerusalem artichokes. And you think you're having fun!"

Charles A. Mortensen of New London was promoted to operations manager at Split Ballbearing Division of MPB Corp. back in December. . . . **Raymond S. Stata,** president, Analog Devices, Inc., was a recipient of the M.I.T. corporate leadership award presented at a luncheon in December. Ray

also made the February '81 issue of *Boston* magazine, picture and all. . . . **Leonard Kedson** stepped down as president of parent company Solid State Scientific, Inc., to become president of SSS Hi-Rel Inc., a subsidiary. . . . A January announcement from Mead Corp., Dayton, Ohio, included promotions for **Michael Allik,** senior vice-president, administration, and **Steven C. Mason,** senior vice-president, operations. . . . The *Harvard Gazette* carried the announcement that **Howard L. Resnikoff** was named associate vice-president for information services and technology at the National Science Foundation. . . . A newsclip shows a picture (with pipe) of **Harry Margulius** announcing that he assumed the position of president and treasurer of Data Technology, Inc., of Woburn Mass. . . . March notes told of **Water A. Ray's** exhilarating experience of climbing the Matterhorn last August. He said it was more fun than aceing his calc exam. . . . interesting comment! . . . **Beniamino A. Inserra** wrote in March that he was working in Guadalajara, Mexico, building a two-piece can plant for American Can Co.; he's chief project manager for Schumacher & Forelli. Hope you didn't drink the water Ben!

Last but definitely not least . . . received a call from **Paul Nicholson.** Plans are moving well for our 25th Reunion. We will be in touch soon with more details. Keep those cards and letters comin' in folks. I hope to be in the country on a more regular basis and should be able to make deadlines without "the long pauses."—**Fred Morefield,** Secretary, Shared Medical Systems, 650 Park Ave., King of Prussia, PA 19406

58

Attentive readers may have noticed (our switchboard was underwhelmed with calls), the blooper in the May notes in which the name was omitted from the last item. If you guessed that it was **John Boynton** who was building the two-place aircraft, you were right. . . . **Bill Hauke** is sticking with building houses. . . . Our peripatetic **Mel Copen** is now the new vice-president for acedemic affairs and dean of the School of Management at Babson College. Previously he was the dean of graduate studies at the College of Business Administration at Georgia State University. . . . **Dana Huestis** has been appointed chairman of the municipal utilities division of the Associated General Contractors of America. . . . **Elisabeth M. Drake** was recently named vice-president of Arthur D. Little in Cambridge. Her area of professional specialization is technological risk management. . . . Last year saw **Robert Spain** running as a candidate for state representative in Massachusetts. Although running as a Republican, Bob was unsuccessful against the Democratic incumbent. Nevertheless, Bob did bring visibility to many key issues and provided the voters with a clear choice. Congratulations are in order to Bob for getting involved.

In the March 1981 issue of I.E.E.E.'s *The Reflector,* your secretary had an article on "Technological Innovation as a Function of Management Risk." He also presented a talk recently to the Society of Women Engineers at M.I.T. on the opportunities for women in consulting and the rewards and risks of starting your own business. . . . **Ed Newton** was recently named vice-president, engineering, at the Gleason Works. Ed previously held the post of manager of corporate planning. On a recent trip to Rochester, I stopped by to see Ed at the Gleason Works and found that he is still keeping up his tennis game.

We were sorry to learn that **Charles Gilliatt** passed away recently after a brief illness. He had recently joined BTU-Bruse, Inc., but for many years was with the Raytheon Co. in Waltham. We extend our sympathy to his wife, Joan, and their two children.

John Seavey reports that "this year is the fourth for my small engineering consulting company, which is specializing in microwave and antenna development work associated with satelite communication systems." Having passed that milestone, it looks as if John will make it the rest of the way. . . . Up in North Anson, Me., **David Ela** is president of the last remaining private utility in the state. In 1977, Dave took over the company following the death of his father, Arthur, whose family had purchased the Carrabassett Light and Power Company in 1921. CL&P still delivers all its bills by hand in order to save the cost of postage, has sought only two rate increases during the last 20 years, and has no debt. Serving only 500 customers with a combined demand of 2000 kilowatts, half of which are consumed by a local saw mill, CL&P has a tradition of personalized service. With the saw mill shifting towards generating its own electricity, however, David is faced with the task of selling the company to a larger utility. Somehow we'd like to see David remain at the big old roll-top desk.

That's all from the North Woods.—**Michael E. Brose,** Secretary, 59 Rutland Square, Boston, MA

59

One way to get a lot of news for a Class Notes column is to miss deadlines for two issues in a row. The stack of material just seems to pile up. A second way is to attend the wedding of a classmate and sit at a table of old friends at the reception. Being resourceful, I have done both.

So, on June 16, June and I attended the wedding of **Philip Richardson** to Diana Edkins at the Unitarian Church of All Souls in New York City. The reception was at Le Veau d'Or, a very fine restaurant closeby. Phil and Diana were gracious hosts, and a "good time was had by all," as the saying goes. Phil, as reported in a previous issue, is associated with Ehrlich-Bober and Co., Inc., and specializes in the financing of municipal projects and in healthcare projects. Diana is on the staff of *Vogue* magazine. . . . Sitting with us were Lydia and **Bob McAuliffe,** who now live in Ridgewood, N.J. Bob, who was Course I, is managing director of facilities engineering for American Can Co. He has worldwide supervisory responsibility for American Can's construction activities. Lydia, whom I first met at the 20th Reunion, manages exports to Germany for a New Jersey company. (I would mention the name, but I can't find my notes.) . . . Dorothy and **Lloyd Howells** were also at our table. Lloyd (Course XV) is an account representative for Keane Associates, Inc., in Waltham, which offers information processing and consulting services. . . . Bess and **Art Collias** also drove in from Boston for the day. Art (Course III) is with Foster Miller Associates, also located in Waltham. . . . Barbara and **Ron Stone** (Course X) were at the next table, but that did not stop the flow of conversation. Ron is still at M.I.T., as director of operations for the Alumni Association. . . . The last classmate I recall being present was **Joe Stella** (Course IV), who is presently a free-lance architect in New York City. He specializes in the reconstruction and modernization of old apartment buildings and has done a great deal of work in both Manhattan and Brooklyn. It was really a great day and an excellent chance to see some old friends. Thanks, Phil, for a 22nd reunion. Do I have any volunteers for a 23rd?

Now for other news and notes: **David J. McGrath, Jr.** was given an M.I.T. corporate leadership award several months ago. David is president of TAD Technical Design Services in Cambridge. . . . The *Boston Globe* contained an article on March 3 that described a "new television show that will bare all about computers." The program is the brainchild of **Patrick J. McGovern** (Course VII), who is founder and chairman of the board of International Data Group, Inc., a privately held market research and publishing concern headquartered in Newton. His organization is perhaps best known as publisher of *Computerworld.* The program will have feature stories about how computers are used and profiles of individuals working with computers. Nationwide showings are planned. . . . **Forrest R. Hanvey, Jr.,** (Course XVI) has been elected vice-president, Systems Engineering, for Western Union Telegraph Corp., Saddle River, N.J. This organization is the principal operating subsidiary of Western Union. . . . Notice comes that **John J. McElroy** (Course II) has joined Simplan Systems, Inc., as president and C.E.O. Simplan is a computer software systems concern located in Chapel Hill,

C. Y. Chin, '59

N.C. . . . **George Luedeke** (Course II) writes on the flap of the envelope containing a gift to the Alumni Fund that he "is still in the advance marine vehicle development field—surface-effect ships, air-cushion vehicles, and small waterplane-area twin hull craft." He is presently responsible for new business development at Rohr Marine, Chula Vista, Calif. . . . Also on the back of an envelope was a note from **Jan Northby** (Course VIII), who is professor of physics at the University of Rhode Island. Jan has just spent a sabbatical year in The Netherlands at the Hamerlingh Onnes Laboratory of the University of Leiden.

G. Elaine Beane (Course XIX) writes that she is in the process of completing her Ph.D. in anthropology and is presently a medical anthropologist working on research in the cultural determination of patient behavior for the Dept. of Obstetrics and Gynecology at the Wayne State University School of Medicine, Detroit. . . . An interesting note comes from **James H. Brown** (Course XVIII). He writes that his daughter Alice is a member of the Class of '84 and that both grandfathers are also alumni of M.I.T.—Harold J. Brown, '30, and John R. Swanton, Jr., '31. My class records show that Jim resides in Cupertino, Calif., and is a principal consultant with Four Phase Systems, a manufacturer of small computers. . . . **Gilbert Y. Chin** (Course III), head of the physical metallurgy and ceramics research and development department at Bell Labs in Murray Hill, N.J., was the recipient of the 1980 achievement award of the Chinese Institute of Engineers, U.S.A. He joined Bell Labs in 1962 and is responsible for research aimed at discovering and developing improved metals, alloys, ceramics, and other crystalline materials for use in telephone equipment. He has authored or coauthored more than 120 technical papers and has been granted eight patents. . . . A press release informs me that **Stanley Sharenson** (Course XXIB) has been named manager of the advanced systems center for Raytheon's missile systems division in Bedford, Mass. Stanley has been with Raytheon since 1968 and resides in Stoneham. . . . Another press release contained the news that **Lawrence G. Roberts** (Course VI) has been elected president of a newly established component within GTE Communications Network Systems called GTE CNS Products. This organization will be responsible for developing and manufacturing new products. The release says Larry began his career at Lincoln Laboratories in 1963 (after getting a Course VI S.M. and Ph.D.) and in 1967 was appointed director of information processing techniques at the Advanced Research Projects Agency of the Department of Defense, where he developed ARPANET, the world's first major packet network. He has received many national awards and is a member of the National Academy of Engineering, I.E.E.E., A.C.M., and Sigma Chi.

Lastly, I must tell you that **David A. Puotinen** (Course X) passed away on February 16, 1981. He was employed by RCA and lived in Plainfield, N.J.

Leo Campbell telephoned the Alumni Office to report that his grandmother found a Class of 1959 ring about 12 years ago with the initials "EBYC, Jr." He has made several previous attempts to find its owner. Mr. Campbell can be reached at the American Birthright Co., (617) 884-1700, extension 312.

Again, my apologies for the long delay between this column and the last. But keep the cards and letters coming, and your comments will appear in print eventually.—**Larry Laben,** Secretary, 310 Rockrimmon Rd., Stamford, CT 06903.

60

My last column was read by three of my four former roomies. **Tom Farquhar** and **Ray Harlan** are rumored to have a contract out on me now, and a third one, **Dick Davidson**, has just surfaced. Dick writes: "My company, RADMAR, Inc., is about to complete its 10th year in business this spring. We make a wild variety of products in the audio-visual field, plus we are a laboratory for filmstrip and slide mastering and duplicating. We get into some interesting special equipment that we make for big companies, too. Right now my biggest thrust is into more and more exporting. It's fun to learn how to handle it, and you also get a better appreciation for the way other people live and attack their problems. My home address is 2100 Techny (note first syllable . . . who's not loyal) Rd., Northbrook, IL 60062; phone (312) 272-7827. If you're ever in the area, please call or stop in." . . . It remains for our other roommate, **Peter Belmont**, former GO player, cellist, and occasional math student, to resurface. . . . Dick also asks, "**Rudy Marloth**, where are you?"

Can any of you account for all of your former roommates? Dick's letter, incidentally, is the only one I have received. All other news herein comes from news clippings or notes on Alumni Fund donations. Do write!

The news lately is strong on honors for our classmates. **Michael L. Besson**, vice-chairman, chief executive officer, director, Certain-Teed Corp., Valley Forge, Pa.; **Howard H. Kehrl**, vice-chairman, General Motors Corp., Detroit, Mich.; and **Donald G. Raymer**, president, Central Illinois Public Service Co., Springfield, Ill., received corporate leadership awards from M.I.T. . . . **Gordon W. Moore** has been awarded the Harold E. Lobdell, Class of 1917, Distinguished Service Award "for extraordinary service to the M.I.T. Club of Colorado and the M.I.T. Alumni Association." . . . **Morris Salame**, who also starred in my last column, has been named a senior fellow at Monsanto in recognition of his significant and continuing technical contribution to the company and his scientific discipline. Morris is an expert in the field of small molecule migration through polymers. . . . **Daniel M. Mitchell** was named 1980 engineer of the year for Collins Telecommunications Products Division of Rockwell International. Congratulations to all these honorees!

Dr. **Linda (Greiner) Sprague**, having returned from China, has been elected president of the American Institute of Decision Sciences. She will serve as president-elect until 1982, when she will replace the current president. Linda has served as AIDS national secretary and vice-president, and continues as director of the executive M.B.A. program at the University of New Hampshire. . . . Dr. **Robert E. Larson** is the 1980-81 vice-president for technical activities of the Institute of Electrical and Electronics Engineers (I.E.E.E.), and has been nominated for the office of 1982 president of I.E.E.E. Bob is the technical director and senior vice-president of Systems Control, Inc., in Palo Alto, Calif. He is a fellow of I.E.E.E. . . . **Gary A. Miller**, a research engineer for Bethlehem Steel Corp., was the principal author of a paper entitled "The Effect of Discontinuities on the Low-Cycle Fatigue of NiMoV (nickel-molybdenum-vanadium) Rotor Forging Steel," which he presented at the International Symposium on Low-Cycle Fatigue in Metals, held at Firminy, France, last November. The paper is to be published in a special A.S.T.M. technical publication. Gary works at the Homer Research Laboratories in Bethlehem, and resides in Hanover Township (Northampton County). . . . **Pete Silverberg** is a senior insulation engineer at Parsons Peebles Electric Products, Inc., where he is responsible for insulation, paint finishes and electrical materials, and most recently for the Class IE Qualification Program. Pete is famous among Cleveland M.I.T. alumni for his reducing diet.

Dr. **John William Poduska** has been elected to the board of directors of Safeguard Business Systems, Inc., a supplier of information services to small business. In 1980, John founded and is chief executive officer of Apollo Computer, Inc., a Boston-area-based manufacturer of high performance, distributed data computer systems. . . . **Richard G. Rogers** has been appointed senior vice-president of Genrad, Inc., Concord, Mass., a manufacturer of electronic systems and instruments. . . . **Lee J. Alter** notes that he is a manufacturers' representative and consultant to the cosmetic industry, and has an M.B.A. from Northeastern University and J.D. from San Fernando Valley College of Law. . . . **Thomas V. Brown** reports that he is chief scientist and vice-president of Applications Research Corp., Dayton, Ohio, and is "very active in the Libertarian Party." . . . **Sheldon L. Epstein** writes: "Epstein Associates continues to prosper in custom microelectronics. Look for our work in the Chevron "Creativity Exhibit" now touring major U.S. & Canadian cities. Current tour schedule includes Philadelphia, Washington, Boston, Atlanta, and Denver." . . . **J. W. Kearney Hibbard** informs us that he has run two marathons, his best time being 3:24:48, and that he is still hoping to break 3:10:00 and run in the Boston Marathon. Perhaps he should organize a marathon for our 25th Reunion! . . . **Howard Hornfeld** writes: "I have started a plastics consulting firm operating worldwide, based on medium-long-range research and development orientation for materials suppliers, as well as supplying Italian chemical customers with products from the U. S.—always more needed! All this happens from my office/home in the countryside near Geneva, Switzerland. Visitors welcome!" . . . **Calvin Hulstein** says: "I am now manager of engineering for the Systems Division of Loctite Corp., and we have a son and daughter in college now. The years of college don't seem that far behind us". . . . while **Lawrence R. Kravitz** relates that he is evaluating the army's new XM1 tank at the Aberdeen Proving Ground, Maryland. . . . **Charles E. McCallum** writes: "I am currently serving as president of the board of trustees of the Grand Rapids Art Museum, shepherding a move into the historic Federal Building, after a $3 million fund-raising campaign. I am also president of the board of Butterworth Hospital, a 520-bed research/teaching hospital in Grand Rapids. These activities are in addition to the very active practice of law, specializing in the corporate/securities area." . . . **Brian R. O'Connor** indicates that he is Midwestern regional manager for printing plate sales, Photo Products Dept., DuPont Co., and very much enjoying life in Lake Forest, Ill. . . . **D. J. Sipos** tells us that his son Peter, 22, is studying architectural engineering at the University of Colorado, and his daughter Pamela, 20, is an executive secretary. He has transferred to Houston and is president of a division of SGL, and he says, "Stop by and say hi."

Walter E. Slager, Jr., says: "Still in Chicago, still in construction business, one child, son in first year of college, recently purchased 45-foot Yawl in Sturgeon Bay, Wisc., to satisfy 25-year ambition." . . . Dr. **David S. Svahn** writes that he has been attending physician in internal medicine at the Mary Imogene Bassett Hospital, Cooperstown, N.Y., since 1972 and that he is active in the teaching and practice of general medicine, with a special interest in hypertension. Dave is also assistant professor of clinical medicine at Columbia University College of Physicians and Surgeons.

Ray Waldmann wrote last December that he had accepted a position in then President-elect Reagan's office as policy coordinator for international economic policy (state, commerce and treasury departments; trade representative, Export-Import Bank, Overseas Private Investment Corp.), and that he would probably return to private law practice in Washington after the inauguration, but then again, maybe not. . . . **Robert Eller** tells us he is working at Arthur D. Little doing management consulting for the plastics industry.

We have also learned that **Ralph E. Harris** died on January 4, 1980. His degree was in architecture, and he was residing in Scottsdale, Ariz., at the time of his death.

That's it for now. More will be forthcoming on the statistics gleaned from the 20th Reunion questionnaire administered by **Tim Hart**, when I get some time and if more news from you all is not forthcoming.—**Noel S. Bartlett**, Secretary, 15320 Edolyn Avenue, Cleveland, OH 44111

62

I received an interesting newspaper article from the *Wadsworth* (Ohio) *News Banner* concerning **Ed Schneider,** who is described as a "kitchen gadget freak" and the owner of two Home Economics stores, one in Akron and one in Medina. The devices he sells include engineering applications, such as a fruit faucet that screws into a lemon or lime and can be turned on and off and a gadget placed in a pan of liquid to be boiled that sets up a surface tension and prevents boil over. Ed demonstrates his wares to various area groups . . . . **Richard Conti** is the manager of the antenna and microwave newtworks section of the Missile Guidance Laboratory at Raytheon's Bedford, Mass., laboratories. . . . **Barry J. Fidelman** has been appointed general manager of the newly established information systems division of Data General Corp. . . . **Don Fraser** has been named vice-president, technical operations, at the C.S. Draper Laboratory (formerly known as the M.I.T. Instrumentation Laboratory), where he has been a staff member since beginning graduate school in 1962. Don will be responsible for the programmatic and technical activities of the laboratory . . . . Also your friendly class secretary **John Prussing** was recently promoted to professor of aeronautical and astronautical engineering at the University of Illinois. His intelligent and beautiful wife, Laurel, is currently in her second term as Champaign County auditor. Their daughters Heidi and Erica are in high school, and Nickie will begin kindergarten this fall.—**John E. Prussing,** Secretary, 2106 Grange Dr., Urbana, IL 61801

63

Short column this month—not much news from you. I hope the summer will rejuvenate your writing skills and give me a good supply of notes for the coming issues of *Technology Review.*

John Lynch writes that he has returned to Lincoln Labs after spending three years managing a continuing education program at M.I.T. for updating engineering skills. The program was called "Tutored Video Instruction." At Lincoln Labs John is working on superconducting circuits for signal processing. He is in the M.I.T. and Cambridge phone books and would be happy to hear from old friends. . . . A press release informs us that **Mike Finson** has been named vice-president and treasurer of Physical Sciences Inc., Woburn, Mass.

Well folks, that's all there is! I hate to threaten you, but if I don't get more info from you I'm going to have to fill up this space with my usual summertime fishing stories. In any case, enjoy your summer vacation.—**Mike Bertin,** Secretary, 18022 Gillman St., Irvine, CA 92715

65

Another thin column this month (I feel like I must have used that line to start a column before), but some pretty interesting news. **Mike Efron,** who started to be involved with kids and their development in the Social Service Committee when we were undergraduates in 1964 and 1965, just kept on moving away from physics and toward education. He worked with the Cambridge Upward Bound program for 10 years and got a master's degree in education and a doctorate in clinical psychology from Harvard. After four years as curriculum leader for reading, guidance and special needs in the Wayland (Mass.) Junior High School, Mike has been appointed principal of the Cape Elizabeth (Me.) High School. High school principalships in New England seem to be very competitive, and Mike was chosen unanimously from a field of 70 applicants and seven finalists. Congratulations and good luck. . . . **Herb Mower** writes that he is serving as an educational councilor for M.I.T. and a director of the Cape Shrine Club Camel Patrol. He is also director of the Grace United Methodist Church handbell choir. . . . **Mike Adler** will be the technical program vice-chairman for the 1981 In-

ternational Electron Devices Meeting of the I.E.E.E. Mike is manager of the device physics unit at the GE research and development center in Schenectady. . . . **Steve Dangel** writes that on a recent business trip to California, he spent the evening with Sherry and **Sid Everett** and their children Jennifer and Greg. Steve says that Sid, with help from his father, has put additions on both ends of his house to create what in monopoly would be called a "Grand Hotel." . . . Anne and I had dinner last week with Ann and **Ed Burke,** who just returned from eight months with Mitre in Athens. The Burkes had a good time and lots of enjoyable traveling and sightseeing, but report that they would just as soon be somewhere else during an earthquake.

That's the lot for this month. Have a nice fall (which I guess is when you get this issue) and write.—**Steve Lipner,** Secretary, 6 Midland Rd., Wellesley, MA 02181

66

We have an amazing amount of news this month. Keep up the good work! My former roommate, **Judith Perolle,** received her Ph.D. in sociology from Brown last year and is now finishing the second year of a teaching appointment at the University of Missouri in the Department of Rural Sociology. Judy—rural? . . . Dr. **Thomas H. Brylawski** has been promoted to full professor at the University of North Carolina at Chapel Hill. His fields of teaching and research are combinatorial theory, combinatorial geometry, and art and mathematics. . . . **David Hayes** has left (temporarily) his wife, Susan, and two sons—Paul, 4, and Patrick, 1—in Schenectady to teach a portion of Union College's Junior Quarter Abroad Program in Bogata, Colombia. The Bogota program is covering Third World development. David is lecturing on technology transfer. I always thought it was the *students* who went abroad for their junior year. . . . On the administrative side, **Ken Browning** is now business manager of Illinois Wesleyan University in Bloomington. He writes that he has followed tradition and bought another large old house.

Leaving the academic world for business, we have **David Vanderscoff** noting that he, Elaine, Jessica, and Jason are enjoying Bismarck, N. D., even the 25-degrees-below-zero winter weather! Since David became president of Northern National Life Insurance Co. two years ago, the insurance in force has increased from 200 million to over one billion. Quite an accomplishment. . . . Dr. **Paul F. Liao** has been named head of the quantum electronics research department of Bell Labs. Paul will be guiding the research for new materials and their uses in communication systems of the future. He has published a large number of articles on nonlinear optics and spectroscopy and has been awarded 10 patents. He and his wife, Karen, live in Fair Haven, N.J., with their two girls, Teresa and Joanna.

Two of our class members have just moved to the D.C. area. After 10 years as a volunteer with IVS (six years in Laos and four in New Guinea), **Allen Inversin** has become a micro-hydro engineer with the National Rural Electric Cooperative. He will assist with requests from the developing world for small, decentralized hydropower programs. He and his wife, Heng, have two sons. . . . **James O. Chinnis, Jr.,** is living in Reston with his wife, Lynn, and daughter, Sarah. He is president of Decision Science Consortium, Inc., of Falls Church, a decision analysis firm involved in structuring judgments about uncertainty and value needed in decision making. . . . Maj. **Jim Kester** sent along this note. "I am wrapping up a three-year tour as commander of a small weather station at Zweibrucken Air Base, West Germany. My wife, Esther, and daughter, Deborah, have enjoyed seeing Europe with me. We were joined in November 1979 by an ornery little boy named Robert, who is dear to our hearts even if he can never be president." Actually, according to our *World Book*, that "natural born" requirement for president has not been fully defined in this sort of case, so don't give up on his chances yet, Jim. They have all now returned to the U.S. for Jim's next tour as a scientific officer at Wright-Patterson AFB, Ohio. . . . **Robert F. Curd** has been promoted from engineering to marketing at Hughes Helicopters. As a major in the Marine Corps Reserve, he is in charge of operations for an ANGLICO Batallion in Long Beach, Calif. He is also a pilot, having just bought a Grumman Cheetah in which to teach flying.

We do our flying in its forerunner, the Grumman Traveler. Here in Port we are all flying our new simulator. The girls enjoy spins and stalls, **William** goes off on long instrument flights, and I get just as nervous flying it straight and level as I do in our real plane. I guess there is no hope. I did accomplish something this month however. I ran in Port's first annual Canoe Place 10km Run and finished, not even last. My daughter was so impressed by her mother's stamina that we are now both preparing for a race later this fall. I'll let you know how we do. Till then, keep writing.—**Eleanore Gieron Klepser,** Secretary, 317 Broad Street, Port Allegany, PA

67

Don Oestreicher has been promoted to manager of VLSI computer aided design development at Xerox in El Segundo, Calif. He received his Ph.D. in computer science from the University of Utah in 1972 and worked at Information Sciences Institute in Marina del Rey, Calif., until 1978, at which time he joined Xerox. He and Joy celebrated their ninth anniversary last April 1 and were expecting their first child (a girl) when Don wrote. Also, he was in training for his third running of the Palos Verdes Marathon; his time last year was 3:27. . . . **Alan Hirch** has been supervisor of data base software support at Standard Oil Co. of Indiana since May 1, 1980. Alan is still "happily single" living in a condominium on Chicago's lake front. He is singing for the 11th season with the Chicago Symphony chorus and is director of District 8 of Tau Beta Pi. . . . **Gerry Marandino** and Laura Acle were married last August. Gerry works for the Information Systems Office in the Department of State and recently was on extended temporary duty in our embassy in Mexico City. . . . **John Patterson** is working as a test pilot and project officer, evaluating new electronic warfare systems for the Navy's fleet fighter and attack airplanes. John is based at NAS Patuxent River, Md. and travels extensively to exciting places like China Lake, Calif.

Larry Taggart left Procter and Gamble last year to become plant manager for Bunge Edible Oil Corp. in Fort Worth, Tex. He and his wife have two children, ages 11 and 8. Larry frequently sees **Tom Solter,** who is with General Dynamics. . . . **Gordon Lee** is co-founder and president of Pacific Contract Services, Inc., an 11-person computer consulting firm in its fourth year of operation in Seattle, Wash. His sons David, 15, and Travis, 13, will both be in high school this year, and his wife Mary is an avid mountain climber and is studying to be a chef. . . . **Keith Patterson** has been promoted to vice president of Botsford Ketchum Public Relations of San Francisco. . . . I was saddened to learn of Bill Hsu's death last January. As an undergraduate, Bill was involved in numerous M.I.T. activities—Freshman Council, Graduation Eve Committee, Institute Committee, and president, Burton House Committee. He was also vice-president of our class, a member of the M.I.T. Alumni Council, and throughout his life an active supporter of M.I.T. He will be missed by all of us who knew him. Our condolences are extended to his family.—**Jim Swanson,** Secretary, 878 Hoffman Terrace, Los Altos, CA 94022

68

As you can see from the address at the end of the column, we have recently moved across the scenic Potomac River to the "Free State." We have bought a new house with the quaint mailing address of Cabin John, Md., although until a few months ago the neighborhood had the better-known address of Bethesda. As we unpacked, we found some notes we received a while ago, so we are combining these with more recent news.

Our first news this month is from Ruth and **Rick Lufkin** who "joyfully announce" the arrival of Alan Spencer on March, 16, 1981—Ruth's 30th birthday. Rick is enjoying his involvement in new business development at Johnson and Johnson and is busy learning various aspects of the medical business and traveling around the country. They were also heavily involved in squaredancing until just prior to Alan's birth. . . . Cheryl and **Leonard Horowitz** have written to announce the birth of their first child, Katie Rebecca, on April 5, 1981. . . . From **Hank Banack** we hear that he received a J.D. degree from the University of Connecticut in 1974 as a followup to an M.S.E.E. received there in 1971. In January 1979 he remarried and his son, David, a "future Institute scholar," was born in November 1979. . . . **Richard Ehrenkranz** is assistant professor of pediatrics and obstetrics and gynecology at Yale and attending physician in the newborn special care unit at Yale-New Haven Hospital. . . . From much warmer climes we hear that **Frederic Nagel** is studying history at the National University of Mexico and that Bertha and he now have three children: Erick, 8, Yvonne, 5, and Vanessa, 3. . . . Judy and **Bob Phair,** and their son, Bobby, 3, moved from Ann Arbor to Baltimore in June 1979. He is now assistant professor of physiology at the Johns Hopkins University School of Medicine working hard to make mathematical modeling a fruitful tool in medical science. Judy is also working full time as an editor for PHH Group, Inc. They report that they "love parenting." . . . **Kay Fields** is now assistant professor of neurology at Albert Einstein College of Medicine where he is doing cell biology, called neuroimmunology, and teaching neurochemistry. . . . Having spent a year at the Federal Trade Commission, **Thomas Romer** is back at Carnegie-Mellon University as associate professor and associate head of the economics department. . . . **Richard Raysman** is a member of the New York City law firm of Brown and Raysman and specializes in law relating to computers. An article of his, "Of Computer and Law," was published last year in the *New York Times* Sunday financial section. . . . From Newport, Vir., we hear that **Alan Covey** now has a family practice of medicine. . . . Since no one came to visit them in Muncie, Ind. **Alexa** and **Peter Sorant** decided to move to New Orleans. Peter is teaching urban planning at the University of New Orleans, while Alexa is a research associate in biometry at the L.S.U. Medical Center. . . . Having spent three years at IBM in microelectronics process engineering and device physics, **Jim Leas** has joined the staff of the Union of Concerned Scientists in Washington.

That's all we have for now. Make note of our new address and drop us a note soon.—**Gail** and **Mike Marcus,** 8026 Cypress Grove Lane, Cabin John, MD 20731

69

Well, not too much news. I was in Atlanta for the American Booksellers Convention two weeks ago and hope to have *Modesty Blaise* out by the time you see the next set of notes. Commencement was yesterday, but our reunion will be in two months, after you have this in your hands. I hope you came.

Jan Jurnecka has completed his residency in general surgery at the University of Arizona and will be spending next year in Dallas on a vascular surgery fellowship. His son Rory is now one year old. . . . **Pamela** and **Alan Goldberg** will be moving to Washington, D.C., this summer. Pamela got an M.B.A. from Sloan yesterday and will be working for a Washington-based consulting firm. Alan hopes to finish his thesis over the summer (about time!).

I didn't have the time to start calling people for news, but will have to if no one writes.—**Robert K. Wiener,** Box 27, M.I.T. Branch, Cambridge, MA

70

Barbara Sollner-Webb is enjoying the task of being assistant professor at John Hopkins Medical School and family person with her spouse and 10-month-old daughter, Lisa. . . . **Christopher Cross,**

along with his wife, Anne, are owners of Sun Energy in Berkshire County (Mass.) and recently designed and built the largest solar home-heating system in the county. . . . **Reed B. Speare** has left the life of beaches in California and has recently assumed employment as an insurance analyst with ITT. . . . **Michael Safonor** is in California, also. He completed his Ph.D. at M.I.T. and is on the faculty of U.S.C. in electrical engineering. . . . **Carl J. Yankowski** is now general manager, marketing, for the housewares department of General Electric's housewares and audio business division. He joins General Electric from the Pepsi-Cola Co., where he was group director of marketing for Brand Pepsi from midyear 1979 until the present. He resides in Stamford, Conn., with his wife, Patti. His office location is in Bridgeport, Conn.

The Alfred P. Sloan Foundation has awarded a two-year research fellowship to **A. Nihat Berker** for further research in physics at M.I.T. . . . **Steven C. Carhart,** analyst in energy services at the Mellon Institute's energy productivity center in Pittsburg, was quoted in a recent article in *Science* with respect to the present administration's energy policies.—**Robert O. Vegeler,** Secretary, Kennerk, Dumas, Burke, Backs, and Salin, 2120 Ft. Wayne National Bank Bldg., Ft. Wayne, IN 46802

71

Doron and **Sandy Bardas** have a new daughter, Tamara, who was born on March 5, 1981. She joins her three-year-old sister, Jessica. The family is happily living on the San Francisco peninsula on the northern edge of the Silicon Valley. Congratulations. . . . **Thomas Cormier,** assistant professor of physics and astronomy at the University of Rochester has received a Sloan Research Fellowship this year. He is conducting research on nuclear reactions and is the author of over 30 research papers. He joined the Rochester faculty in 1978 and was a visiting scientist at the Max Planck Institut f. Kernphysik in Heidelberg, 1977-78. . . . **William R. Hively** married Claire Lijen Bien and is in Princeton, N.J., working as an editor for the Princeton University Press and writing a Ph.D. dissertation in American history for the University of California, Santa Barbara.

It is my sad duty to report the death of **Frederick Morrison** in May 1980.—**Hal Moorman,** P.O. Box 1808 Brenham, TX 77833

72

Bonny Kellermann writes, "Hard to believe, but it's time to start planning for our 10th Reunion. Everyone's help is needed to assure that this will be an event which is appealing for the class. If you have any ideas about what you would like to see included as part of our activities, please contact me at my M.I.T. office—Room 10-186, (617) 253-3354—or at home—59 Eliot Crescent, Brookline, Mass., (617) 232-0988. We need people from the Boston area to serve on the Reunion Committee to decide what we're going to do and how to do it. If you're too far away to do this, please write to share your ideas. In any case, circle June 10-13, 1982, on your calendar and start making plans to come to our reunion."

Mark Levenson is doing materials research at Bell Labs in Murray Hill, N.J., after getting his Sc.D. in materials science in 1977 and spending two years as a postdoc at the University of Geneva . . . . **George Flint** is an attorney with the firm of Bedsole & Bird . . . . **Gregory Withers** is doing research in agricultural chemicals for American Cyanamid in Princeton after a Ph.D. in chemistry from Rutgers and postdoctoral research at the University of Pittsburgh . . . . **Dennis Biedrzycki** had a third son, Jason, in December . . . . Sharon and **Maury Goodman** had a daughter, Leah, in November . . . . **Ludo Gelders** is professor of industrial and systems engineering at the Katholieke Universiteit Leuven and was elected treasurer of S.E.F.I. (European Society for Engineering Education) . . . . After three years in applied social research, **James Lowe** is operating his own business, a 2300-acre cattle ranch in the Nebraska sandhills and writing his Ph.D. dissertation in applied anthropology "during slower seasons." . . . **Martin Bilsker** is doing a cardiology fellowship at the University of Miami. He was married in June 1979 to Beverly Eisenstadt, who recently finished a Ph.D. in English at Columbia and is on the English faculty . . . . **Mark Koenigsberg** taught math at Texas A & M and is now at Bell Labs in Murray Hill, N.J. He would like to hear from MacGregor-C people . . . . **Mark Norstein** reports that his son Keith just turned 1 in February. He opened a medical office in November and is "working harder now than I did as an intern." . . . **Wiliam Greig** is currently working as a petroleum analyst in the investment division of the Philadelphia National Bank. He got his M.B.A. from Wharton in 1978 and is oil & economics editor of *Strategic Currents.*—**Dick Fletcher,** Secretary, 135 West St., Braintree, MA 02184

73

Greetings from wherever. **Chris Tavares** is a technical consultant for Honeywell here in McLean, Vir., specializing in the Multics system (". . . and still loving it after all these years."). In his spare time he publishes *Model Rocketeer,* which after 20 years of operation will be hitting hobby shops shortly. . . . **Paul Green II** left Honeywell and Multics a year ago to help start Stratus Corp. (computers). They well may announce their first product later this year. Paul has spent his last seven years working with M.I.T. Community Players, where he met his wife of six years, Marty (Mt. Holyoke, '67), with whom he expects child #1 late this year. He is still involved with WMBR and is treasurer of Technology Broadcasting Corp., which irrelevantly reminds me of the old TBS on-air man who botched up a religious announcement: "Stay tuned for our sermonette, whose topic will be 'cast thy broad upon the waters.' This is Technology Breadcasting System."

Paul Shapiro briefly noted that his report entitled "Science and Technology in World Bank Operations" was published by the World Bank in September 1980. . . . Prof. **David Jansson** has helped develop a 3-D video system capable of displaying moving objects. . . . **Greg Daley** must be reading this column faithfully. He writes, "Although I'm not a doctor, I thought I'd try writing anyway." Now there's a good fellow. Greg lives in Dallas with wife, Rhonda, and is an assistant v.p. with Republic National Bank of Dallas in the petroleum and minerals department. Now, nobody laugh, because back in North Carolina we had tobacco departments in our banks. Seriously, we are proud of Greg's new position and wish him well. Several of our classmates are in Big D and environs, and might want to look him up. Even, as he says, if he hasn't lent J.R. Ewing any money yet.

John Purbrick, another letterer, has been the token M.E. in research at M.I.T.'s Artificial Intelligence Lab (producing Massachusetts legislators, I wonder?). The job has the fringe benefit of being able to tell people, "I design robots at M.I.T." John went to England this spring to give a talk about one of his inventions on, of course, April 1. Aside to John: even if you're not constantly moving from place to place, your life is not dull to us, and we love to hear from you!

I don't know what **Tony Scandora** is up to. Yours 2 a.m.-feedingly is tired. This Jr., at two months, may soon find himself for sale if he doesn't learn to sleep nights!—**Robert M. O. Sutton, Sr.,** 819 Buckingham Ct., Warrenton, VA 22186

75

This month's column opens on a very sad note. I have recently learned about the death in May of one of our classmates. An obituary concerning **Susan A. Mortensen** (maiden name, Ashworth) was printed by a Kansas City paper. Susan graduated from M.I.T. with a degree in civil engineering and was employed for five years by the firm of Black & Veatch. She was married to Nils Mortensen and was a founder of the Society of Women Engineers of Kansas City. My condolences to her parents, Mr. and Mrs. Alfred Ashworth of Marshfield, Mass.

Diane Bracken is project manager for an interactive graphics system for IC design at Hewlett Packard. . . . **David Katz** says he has been put in charge of the air-quality monitoring projects at Burns and McDonnell, the Kansas City A/E where he has been working since 1979. Project sites include Hugo, Ok., and Rockdale, Tex. "When I get free time," David says, "I write proposals." . . . **Elizabeth Zahniser** and her husband have moved back from The Netherlands to the Boston area. They bought a house (their first) at 33 Sheridan Rd., Wellesley. How do they like it? "Love it, but it's work. We would love to hear from people," they add. . . . **Peter Schulz** has been a postdoc in chemical physics in Boulder, Colo., for one and a half years. He found the '80-'81 ski season disappointing. Hence he decided that "it's time to look for a real job, which I am presently doing." . . . **Jay Nadelson** opened a commercial photography studio in New York City doing advertising and editorial photography. He is also involved in documentary films. . . . After spending a year as a postdoctoral fellow at NYU's Courant Institute, **Paul H. Siegel** is now at IBM research in San Jose as a member of the magnetic recording channels group. "It's a far cry from doing research in algebraic topology, but all those math courses (yes, even topology) have come in handy. Six months and I'm already a devoted IBMer. How can you help but love a company that lets you pick plums and walnuts from the backyard orchards after lunch?".

Weddings and births. **Paul R. Giguere** married Brenda N. Cox of Concord, Calif., on March 8, 1980. "The wedding took place at the MGM Hotel in Reno (No, the one that burned was in Las Vegas)." Paul has been working for the water resources division of Camp Dresser & McKee for five years and was recently promoted to senior engineer. . . . "Two Techs are better than one," or at least so think **Wendy Landman** and **Joel Weissman.** They were married in May and still live in Cambridge. Joel is teaching community health policy at the Mass. College of Pharmacy, and Wendy is an environmental planner at a Cambridge architecture/planning firm. . . . **Kathryn J. Browning Hoffmann** had a second child, a baby girl born December 29, 1980, at 10 lbs, one-half oz., named Dorothy Ann. Her first child, James, was three years old last May. Congratulations!

In other news, **Thomas F. McKim** works at the Washington, D.C., law firm of Jones, Day, Reavis & Pogue, doing mostly antitrust litigation. "Although I expected the practice of law to involve considerably less emphasis on technology than life at the Institute, I have been pleasantly surprised to find that it pervades virtually every case on which I have worked. In terms of leisure activities, I continue to fly whenever possible; I've been able to fly back to Boston and revisit Hanscom Field, where I spent so much time as an undergraduate." (Hanscom Field is an Air Force and general aviation airport near Routes 2 and 128.) . . . **Daniel B. Jones** is working in Richmond, Calif., for Cal Recovery Systems, a research and consulting firm in the field of resource recovery from wastes—mainly sewage and municipal garbage. Poking fun at something I wrote in this column a few months ago Daniel adds, "Last books read: *War and Peace* and *The Greek Way.* Favorite scotch: After a day in the garbage, whatever is offered is fine."—**Alex Castaldo,** Secretary, 929 Mass. Ave. (12D), Cambridge MA 02139

76

Your secretary apologizes for the brevity of these notes. However, the next issue will contain reunion vignettes, which should be a bit longer. . . . *From the mails:* "Currently working at Aerospace Corp., Los Angeles; nearing end of writing of thesis (Ph.D.) in materials science from Cornell."—**Leslie Feldman.** . . . "I am a lawyer specializing in real estate with Greenbaum, Wolff, and Ernst."—**Paul A. Fryd.** . . . **Phil Giangara** writes, "Employed at Codex Corp. designing ICs and TT2 breadboards, in Mansfield, Mass. Bought a house in Mansfield. Married Barbara Richardt. One child, David, 2. Still playing table tennis in Providence, R.I." . . . **Bill**

How to Mix Show Business, Wrestling, and Computers

Erland van Lidth de Jeude, '76, has three careers going at once these days—computer science, amateur wrestling, and show business. Mr. van Lidth de Jeude, who is six-and-a-half feet tall and weighs 380 pounds, has made his mark in two films in which he plays fearsome, violent characters. His first role was as a punk called Terror in the 1979 gang movie *The Wanderers*. He is currently being seen in the Richard Pryor-Gene Wilder comedy, *Stir Crazy*, as Grossberger, a mass murderer Wilder and Pryor meet in prison.

People Weekly magazine, in a February 23 feature on Mr. van Lidth de Jeude (they call him "an M.I.T.-educated genius") says he makes other movie heavies look like flyweights. "Erland is Mr. Bad, nay, Lord Bad these days, and a memorable draw who has helped *Stir Crazy* gross $78 million as the comedy smash of the year."

But for an actors' strike, Mr. van Lidth de Jeude's promising operatic voice (he is currently studying voice in New York) would have been heard in *Stir Crazy* when Grossberger sings "Down in the Valley." The labor problem resulted in the use of a song recorded before the movie was made.

Meanwhile, his ambition to make the U.S. Olympic team as a wrestler and to sing the National Anthem at the games remains unrealized. He was ranked second in the United States in 1979 in both freestyle and Greco-Roman wrestling. The United States' boycott of the summer Olympics put those hopes on hold. He plans to pursue his show business career and evaluate his 1984 Olympic chances in a couple of years.

Mr. van Lidth de Jeude was signed for a role in John Derek's version of *Tarzan the Ape Man*, which will star Bo Derek.

"When I got to Sri Lanka, where the movie will be made, the first thing they wanted me to do was shave my head," Mr. van Lidth de Jeude said when we reached him at his New York apartment only a few hours after he had returned from Sri Lanka. "When an actor shaves his head for a role," he said, "he puts himself out of contention for other roles for a long period of time. His compensation should reflect that. My contract said nothing about shaving my head. I was willing to do it (his role in *Stir Crazy* is as a baldie) but John Derek wouldn't renegotiate my contract. After talking with my agent, I got back on a plane for New York. They had to pay me because we had a contract, and they paid for the transportation too."

When he's not negotiating the price of haircuts in the jungles of Sri Lanka or studying voice in New York City, Mr. van Lidth de Jeude earns his keep as a computer consultant. He can also be found a couple of times a week singing in Asti's, a Greenwich Village restaurant where the opera crowd hangs out.—*Robert C. Di Iorio*, Tech Talk

A toast to the newly refurbished lobby at the junction of Buildings 6 and 2 by members of M.I.T.'s Class of '79. Following the precedent set last year by Class of '78, these enthusiastic '79ers asked Class of '29 to match their gift of $1,398, which they personally solicited from their living groups. The new benches and plants are for the purpose of enhancing student life at M.I.T. (Photo: Calvin Campbell)

Ezell writes, "Running my second company—doing compiler development under UNIX. Marta Greenberg, '75, just joined. Have several new hobbies—flying, scuba diving, and Ferraris." . . . And from **Steve Edelson**: "Received M.B.A. '80 from Harvard. Working for Strategic Information in Burlington. Moved to Wayland, Mass."

As for your secretary, he remains sorely pressed for time. He has been trading a lot of Swiss Franc futures, and having alternate bouts of fun and horror. The Swiss Franc futures pit has been nicknamed, in Chicago, the pirahna pit. Other roller-coaster markets—coffee and sugar. The next column will have reunion details, so stay tuned. Knowing some of our classmates, it's bound to be interesting.—**Arthur J. Carp,** Secretary, Sandro Rohstoff, Inc., Suite 9853, New York, N.Y. 10048

80

I hope you all had an enjoyable summer. It's three months from press to public, so the summer will have passed by the time you read this. They say no news is good news; old news is just O.K., I guess.

Overheard at a "graduation" party for **Jim Boots**, who finished his sales training program and is now based in Chicago with Chevron Chemical, petrochemicals division: **Tom Drake** is at U.C.L.A. grad school along with **Steve Mardeuz** and **Steve Semken**. Mr. Semken's studies take him to the Mojave Desert, where it's rumored he will be battling rattlesnakes until his marriage to Kim Crocker of Wellesley later this year. Kim, much happiness to you both, but request a more civilized place for a honeymoon. . . . Two classmates who have recently proven that a diamond and a man can be a woman's best friend: **Joan Whitten,** now at Harvard Medical School, will be tying the knot with John B. Miller, '74, in late August. **Sue Rose** has recently announced her engagement to Hugh Pinkus, a gentleman from Cornell, now at the University of Chicago. They are planning a June wedding. Congratulations to both of you and the lucky guy as well.

And who's that on the cover of *Rolling Stone*—I mean, the 1980-81 M.I.T. Catalogue (close enough): **Barry Star, Kevin Campbell, Arnold Chien, David Chin, Gary Cohen, Mark Connaughton,** and **Dan D'Eramo**. Whereabouts unknown, but nice smiles, guys. . . . One day, I was out at Pier 39 on the S.F. waterfront and who should I run into but **Cammy Abernathy** and **Mary Krull.** Cammy is at Stanford working on her Ph.D., finding it quite interesting. Mary, having decided to join the workforce, drove cross country in some record time and has begun work for Rockadyne in Los Angeles. . . . **Wes Asbury** gave a presentation recently at the Lawrence Livermore Lab, coming out from Oak Ridge, Tenn. He managed to catch a few days here in San Francisco. He got the culture tour (Chinatown, cable car, Rice-a-Roni, the wharf), the classic S.F. fern-bar tour, and the hill tour (Nob, Telegraph, Russian). Asked which one he preferred, without a moment's hesitation Wes replied, "Tour B, of course."

Write-ins from afar: **Constantin Salame** is "assessing studies of renewable energy systems for residential, agricultural, industrial and remote applications with emphasis on wind energy conversion systems and photovoltaic systems." Great, Constantin, but you didn't tell us where. Oh, well, something for the next column. . . . **Curtis Pearlman** is presently employed by Lexar Corp., in Los Angeles, "where my E.E. talents are receiving great exercise and challenge." Lexar is presently in the research and development stage of a new digital pbx system soon to compete with companies such as Rohm, Intertel, etc. . . . At the Naval Officers Candidate School in Newport, R.I., is **Evan Hammerman. . . . Sheila Konecke** writes that she is working for IBM in manufacturing engineering, Burlington, Ver., and will be transferred to Manassas, Vir, later this summer. . . . I ran into **Paul Weiss**, formerly the choice voice of the men's heavyweight crew team, at a regatta in Oakland. Paul is working toward his Ph.D. in chemistry at Berkeley and keeps up his coxswaining profession with the Berkeley Alumni Rowers.

Alas Chevron has sent me to spend eight days at Disneyland in Anaheim, Calif., for the Society of Women Engineers Conference and a few days in New Orleans at our plant—all in a day's work. At this rate, I could turn up anywhere. I just bought a camera, so if you don't write, the eye may be on you. And remember, we allow equal editorial space here. Keep in touch.—**Debbe Utko,** Assistant Secretary, 1730 Sacramento St., #8, San Francisco, CA 94109

Even the Automobile Has a Rosy Future as 2,500 Alumni Return to Cambridge

Young and old, graduates from 1910 to 1981, they came from everywhere—over 40 states and 13 foreign countries, including India, China, the Phillipines, and Spain. And they went everywhere and did everything. No part of Cambridge, Boston, and the shore from Cape Ann to Cape Cod was immune from their attack.

At 2,500, the reunions and Technology Day of 1981 set new records for numbers. And with gifts of over $6.2 million from the four principal reunion classes, there was a record outpouring of confidence and goodwill—including an honorary membership in the Class of 1921—for President Paul E. Gray, '54, at the end of his first year in that office.

Optimism even found its way into a day-long seminar session devoted to

the future of the automobile. No one predicted the return of the classics—the Cadillacs, Lincolns, and Imperials and such exotics as Marmons, Stutzes, and Packards. But the changes in the American automobile and the industry that produces it have clearly only begun. New techniques for optimization will yield significantly greater efficiency in tomorrow's cars, said Professor John B. Heywood, Ph.D. '65, director of the Sloan Automotive Laboratory. And new technologies will transform the automobile into a high-technology product, said Howard H. Kehrl, vice-chairman of General Motors. But one key question for the future went unanswered: Can Detroit overcome the $1,300 cost differential between making a small car in the U.S. and in Japan? General Motors' optimism was made obvious by the exhibit of its experimental two-passenger commuting car which yields more miles per gallon than any gasoline-powered vehicle now made in the U.S. When would GM make it? "Soon."

$6.2 Million of Caring for M.I.T.

To the four classes who reported anniversary gifts at the Technology Day luncheon, President Gray responded that he could think of "no better capstone" to his first year as president than to be "a partner in—and a recipient of—your caring for the Institute."

The four gifts that brought this accolade from President Gray were:

☐ $3.137 million from the 50th anniversary Class of 1931—the second largest 50th-reunion total ever recorded at M.I.T. Included was the contribution of Kenneth J. Germeshausen, the reunion gift chairman, to the EG&G Education and Seminar Center of the Department of Electrical Engineering and Computer Science, for which the ground breaking was a feature of the 50-year class' reunion (*see below*).

☐ $1.362 million (another second-highest-in-history total) from the Class of 1941 on its 40th anniversary. Included, said Frank S. Wyle, gift chairman, were gifts and pledges of over $640,000 towards a Class of 1941 Professorship.

☐ $600,000 from Class of 1956 celebrating its 25th reunion. Roger S. Borovoy, reunion gift chairman, said that over half the total was earmarked for a Career Development Professorship to honor the late Professor Samuel J. Mason, Sc.D. '51, of the Department of Electrical Engineering.

☐ $2,277 from the Class of 1981, graduated five days earlier. This fund, said Mitchell Brook, president of the Class, had been matched by the Class of 1931 and would make possible a barbeque/picnic area on the West Campus. A more important announcement from Mr. Brook followed: members of the class have pledged a total of over $12,500 for M.I.T. by 1986.

In addition, the Class of 1921 announced at its own 60th reunion banquet on June 5 that its total giving to M.I.T. during the last five years was over $1.131 million—one of the largest 60-year gifts ever reported.

James J. Snyder, '81

At 104, You Can't Do It All

The oldest alumni at the luncheon were Ralph W. Horne, '10 and Arthur Curtis, '10, president and vice-president, respectively, of their class. And laurels also went to Norman E. Seavy, '99, of Orlando, Fla., who had written to Harl P. Aldrich, '47, president of the Alumni Association: "I'm sorry I can't be there; but when you get to be 104 years there are some things you can't do."

There were honorary memberships in the Alumni Association for three guests:

☐ Joseph J. Martori, associate secretary of the Alumni Association ("dedicated, devoted, and creative");

☐ Conchita Lobdell Pearson, the beloved widow of two M.I.T. alumni who is "senora M.I.T. in Mexico";

☐ James N. Phinney, New York district director for resource development ("lives, breathes, and sleeps M.I.T. and knows more alumni in New York than all the rest of us put together").

One if by Bus, Two if by Boat

The largest single event of the extended weekend was "M.I.T. Night at the Pops" on June 4—a near sellout crowd of 2,250 for a program conducted by Bruce Hangen, music director and conductor of the Portland (Maine) Symphony.

Other weekend highlights included trips between the Museum of Transportion and M.I.T. aboard the steamship *Calliope* (1961-1976), a Boston Harbor cruise aboard the new *George's Island* (1941), an evening at the Museum of Fine Arts (1951, the biggest 30th reunion in M.I.T. history), dinner at the State Street Roof overlooking Boston Harbor (1931), a superb clambake with all the fixin's at the Rockport Country Club (1941), another at the home of William E. Northfield, '56, in Osterville (1956), and yet a third at the Corinthian Yacht Club, Marblehead (1951), and brunches in the Summit Room of the John Hancock Tower (1976 and 1966).

While most classes focussed their reunions on the campus, where nostalgia flows most freely, five chose second locations: Endicott House (1916), the Chatham Bars Inn (1926), Harbour View Hotel on Martha's Vineyard (1931), the Wychmere Harbor Club (1936), and the Woodstock (Vt.) Inn (1946). To take everyone to these many destinations required 100 scheduled trips by chartered bus and boat—a prodigious orga-

nizational effort credited to Mr. Martori (Technology Day), Frances Bangs (reunions) and their assistants Janet Lambert and Christine Newman. In four days of reunion activity more than 1,100 visitors were accommodated in the dormitories; and thirty receptions were served in upwards of 20 different campus locations under the direction of Salvatore Lauricella, special functions manager for the M.I.T. Housing and Food Services.

In one sense the varied locations added vital spice and excitement. But in another sense they really didn't matter: everywhere it was the same—an outpouring of comradeship and good cheer, a five-day dawn-to-midnight demonstration of the "deep loyalty and pride" of alumni in their *alma mater* which President-Emeritus James R. Killian, Jr., '26, cited in his moving address to the Technology Day Memorial Service whose pulpit he shared with Melissa B. Teixeira, '44.

After 25 and 50 Years, What They Say About Themselves

It says in the legend that M.I.T. people have "the habit of success," a phrase attributed to the late Vannevar Bush, '16. If you doubt it, you have only to look in the books published by the Institute's sons and daughters as they prepare for the major anniversaries of those days when it all began.

Look, for example, in the 25th reunion book of the Class of 1956: after 25 years, the addiction to hard work and the habit of life on a fast track is revealed on almost every page: research chemist at the University of California at San Diego . . . president and chief operating officer of a firm which employs upwards of 200 people . . . extensive writing and lecturing to professional groups . . . a multifamily commercial builder whose goal in the 1970s was to "build as much as possible" . . . professor of chemical engineering and dean-designate of the college of engineering . . . portfolio manager for a $700-million mutual fund . . . installation and testing of a digital control system on the world's largest hydrofoil . . . "directly involved in shaping Colombia's industrial and energy policies" . . . co-author of *The People's Handbook of Medical Care* and of *Mademoiselle* magazine's medical advice column . . . in charge of engineering design, supervising 180 people in our Ann Arbor office and 70 in our Toronto office . . . president and chairman of Tyco Laboratories, Inc. . . . a thriving architectural practice, much passive solar . . . business and technical adviser for Exxon operations throughout the Middle East . . . manager of research engineering. . . "started a consulting firm, worked hard to grow it to more than 100 people" . . . owner of a common stock analysis and advisory firm . . .vice-president—research and development . . . real-estate broker, formerly feature writer for various newspapers . . . vice-president—mergers and acquisitions.

In another 25 years, back at M.I.T. for another milestone, most members of the Class of 1956 will be retired. What then?

Life will be slowing down—but very good. Here is what some of the Class of 1931 write of their activities in their 50th reunion book: "a track and field nut—have travelled extensively all around the world, attended all Olympic Games starting in 1964 except 1980 at Moscow" . . . "last year we headed west driving more than 15,000 miles in 15 weeks, roughly following the route I took with a friend in a Model A roadster exactly 50 years earlier" . . . total lifetime travel: "350,000 miles in 121 countries by air, rail, ship, boat, bus, cars, horse, elephant, and camel" . . . "former member of the New Hampshire House of Representatives, Chamber of Commerce 'man of the year,' still a country lawyer" . . . "currently studying Houdini escape techniques in order to decouple myself from consulting" . . . "restoring a 1790 Cape house to museum standards, maker of reproduction furniture, lecturer on the Shakers " . . . "student at the University of Hawaii since 1975, earned M.A. in 1977 and hope to get Ph.D. in 1981" . . . "looking for oil and gas in the U.S. and Canada is a great adventure, so why retire?"

But for some members of the Class of 1956, leisure came early—or perhaps it's a sense of humor about the competitive drive to success of their classmates. A resident of Temecula, Calif., confesses to "some success with rattlesnake avoidance . . . accumulating one of the world's significant collections of useless knowledge and cast-off anachronisms." A senior transportation engineer for the state of Texas notes his hobby: "riding Amtrak." In Norris, Minnesota, the minister of the United Church of Christ reports that he is "an active weaver, dulcimer builder and player, and canoeist." And then there's the 25-year man who "works an average of about four hours a day for around 150 days a year . . . loaf the rest of the time."

Back at M.I.T. after 50 years and more! ***Top:*** *Kenneth J. Germeshausen, '31, reports for his class at the Technology Day luncheon—$3.137 million and a bronze beaver for M.I.T.* ***Middle:*** *President Paul E. Gray, '54, reports to the 50-year class assembled in his garden.* ***Below:*** *President and Mrs. James R. Killian, Jr., with his classmates of the class of 1926 at the M.I.T. Museum.*

Photo page A21:
James J. Snyder, '81

New EG&G Education Center; Reminiscences Enhance Groundbreaking

"The basic process of preparing and helping to educate remarkable young people requires three basic components: an outstanding faculty, a talented student body, and more-than-adequate facilities," Howard Johnson told a large audience in Building 10-250.

The occasion: a groundbreaking ceremony to mark the symbolic start of building a new facility for the Department of Electrical Engineering and Computer Science, made possible by the joint efforts of Harold Edgerton, '27, Kenneth J. Germeshausen, '31, and Herbert E. Grier, '33, and their wives, hence the name: the EG&G Education Center. The five-story center will be built as an addition to the Sherman Fairchild Building (buildings 38 and 36). It will include a lecture hall seating 330 people, four classrooms, a conference room for 125 people and an undergraduate electronics laboratory, and it will be ready to relieve the space crunch of the Institute's largest department by the late spring of 1982.

The ceremony coincided with the 50th anniversary celebration of Mr. Germeshausen's class. His contribution toward the EG&G Center was part of the $3,137,009 gift of the Class of 1931.

Some excerpts from the speakers for the occasion:

Doc Edgerton: "I'm always amazed when I give a quiz to see how little of the information I gave those kids comes back. When I first wondered (*sic*—a typo made by his secretary that he thought relevant) into M.I.T. through the front door, tuition was $200 a term. I remember Vannevar Bush took me apart on my first paper; it was like going through a lawnmower. I hope we keep that up and work these kids over. Of course there's a lot of geniuses coming here now—we have to be careful with them . . . As a lab man I have a biased view—classrooms and labs are a very important part of the educational process."

Ken Germeshausen reminisced: "When I graduated, after a lot of looking, my only offer was from a trucking company; they apparently thought it would add to their image to have an electrical engineer on the staff. Doc asked if I'd like to work with him to seek applications for the strobe. Having nothing else to do, I said sure.

"Our first application was for a paper company, to study how fibers are formed that are used in fiberglass textiles. Our early pictures worked better in the sales department than the engineering department.

"We had personal bank accounts and a partnership account. As I recall, they used to get mixed up now and then.

"We researched other applications on weekends and nights. The lamp was one of the key elements. The first strobe was just a spark gap. It made a tremendous racket and it was not very efficient.

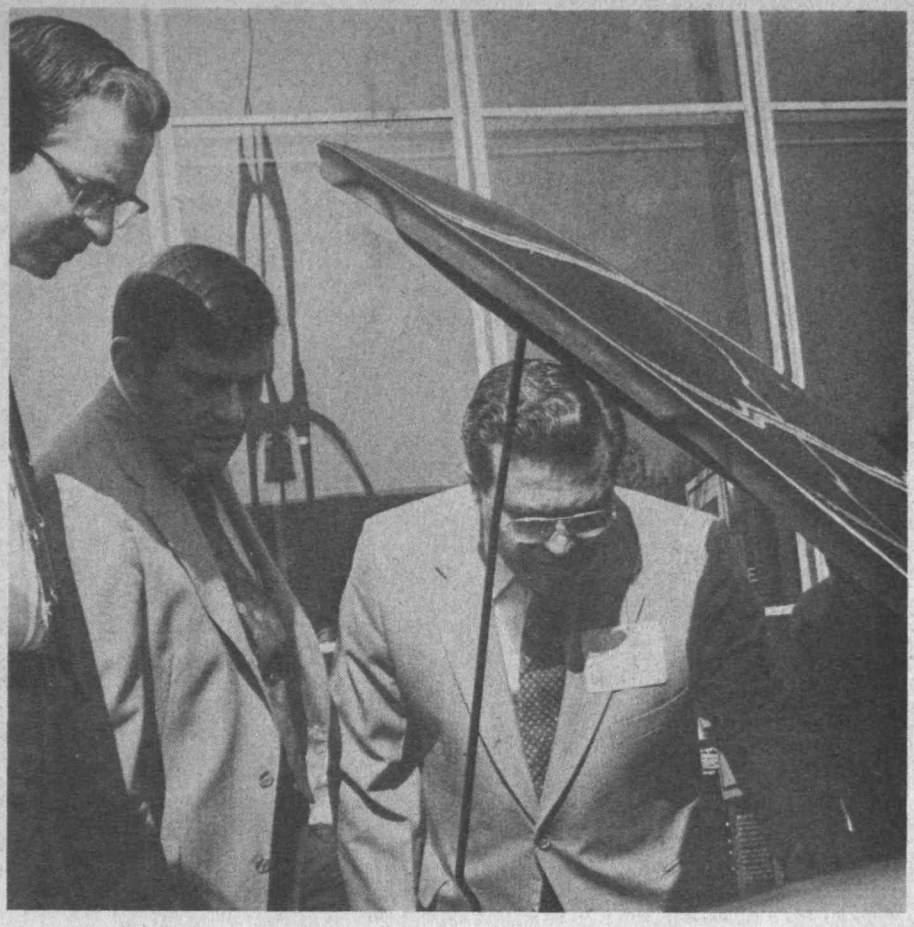
"Our partnership ended up with over 100 patents. Business kept getting better. Grier joined us in 1934. We thought we might start a company and build a strobescope of our own. Then the war came, and Grier went into nuclear weapons, Doc into photos, and I ended up in the Radiation Lab. Strobe work had a marked similarity with nuclear weapons firing.

"We came to the conclusion, after the war, that we'd start a corporation. Through all the changes, our partnership continued. We got together and worked out problems. Then it terminated in the 60s because of certain conflicts between interests. But in order to dissolve a partnership, you have to have an agreement to start one. So we drew up a one page agreement and immediately dissolved it."

Bernard O'Keefe, president of EG&G: "In 1945, I was assigned to M.I.T. as a Naval officer. When I got out of the service, I stayed at M.I.T. and put an M.I.T. hat on. When we started the

Left: *They manned shovels in 1981 with the same carefree spirit they swapped oscilloscopes in days long past. Left to right at a symbolic groundbreaking for the new EG&G Education Center on June 4: Howard W. Johnson, chairman of the Corporation; Paul E. Gray, '54, president; Gerald L. Wilson, '61, head of the Department of Electrical Engineering and Computer Science; Kenneth J. Germeshausen, '31, chairman of his class reunion gift committee; Harold E. Edgerton, Sc.D. '31, Institute Professor emeritus; Gordon S. Brown, '31, former dean of engineering, and Jerome B. Wiesner, president-emeritus. (Photo: John A. Tucker)*

Right: *Pondering the future of General Motors' two-passenger minicar on the Kresge Plaza on Technology Day: (left to right) Thomas H. Farquhar, '60, senior vice president of Massachusetts Financial Service Co.; Herbert H. Richardson, '53, head of the Department of Mechanical Engineering; and Vincent A. Fulmer, S.M. '53, secretary of the Corporation.*



corporation, I put an EG&G hat on. When the academic institution decided to get out of defense and military research, we moved to Brookline Avenue. As we grew, I instituted a few controls.

One of them was a locked stock room complete with a wire mesh which I put up. Edgerton came in over the weekend, decided he needed something, and cut through the wire mesh.

"One day I couldn't find a $10,000 scope; it turned out Edgerton had checked it out and gone off with Jacques Cousteau. When he returned, I asked where it was. He said he lost it overseas somewhere near Greece. "What will we do—it's government property," I said. "That's easy," he said. "Fix up the other and change the nameplate."

Edgerton still calls me "the boy," he added.—*M.L.*

High Technology to the Rescue in Detroit

Struck down by a landslide of high fuel prices and high interest rates, the U.S. auto industry is laboriously climbing back toward the pinnacle of world leadership it enjoyed for more than 50 years. Can it reach that peak again? And—buffeted by storms of change much stronger than ever before—can it stay there?

The magic number is $1,300, Marina V.N. Whitman, vice-president and chief economist of General Motors, told the automotive symposium on Technology Day. That's the cost advantage which the Japanese now enjoy over the U.S. in making a typical small car. About half of that difference is due to the higher cost and lower productivity of U.S. labor—a difference of about $8 per hour, Dr. Whitman said. The rest has to do with technology and the cost of materials—glass, plastics, and rubber.

If the U.S. industry is to succeed it most conquer this price disadvantage, and the solution is obvious: improve efficiencies by designing vehicles that are easier to manufacture and manufacturing systems that are less costly to operate.

Dr. Whitman struck a tender spot for Stephen I. Schlossberg, director of government affairs for the United Auto Workers. "We will not have feudalism in America," he said, almost shouting. The Japanese style of unswerving loyalty to job and company is not for the UAW. ". . . We don't do it that way in America," he said.

Elements of Change: Labor, Technology, and Demand

Though both government and management representatives at the day-long Technology Day symposium agreed that the adversarial relationship between labor and management which characterized the 1960s and 1970s is fading, Professor Harry C. Katz of the Sloan School of Management suggested more problems in the future. Recent practice has been that labor agreements worked out with any one company in the industry automatically applied to all the others. But now American companies are "strikingly different" in their profitability, said Professor Katz, and what unions accept from one company they may not accept from the next. There's at least the potential for "an explosion of labor-management tensions" in the industry, he thinks.

There's lots of room for improvement in the U.S. auto industry's quest for better, more economical, and less costly designs, said Professor John D. Heywood, Ph.D.'65, director of M.I.T.'s Sloan Automotive Laboratory. And that

doesn't mean radical change; it means gradual optimization of all the systems that comprise the modern automobile, "a steady effort affecting every aspect of the vehicle." Indeed, Professor Heywood thinks a 50-percent improvement in engine and power-train efficiency is possible during the next 20 years; his crystal ball for the year 2000 shows cars travelling between 40 and 75 miles per gallon.

Howard H. Kehrl, vice chairman of General Motors, brought with him to the Kresge Plaza an example: a prototype two-passenger high-economy GM vehicle rated at over 30 miles per gallon with a conventional four-cylinder engine and 42 miles per gallon with an experimental three-cylinder engine. Driven at a steady 25 miles an hour, this tidy little number would run for 86 miles on the highway before consuming a full gallon of fuel. The crowds of alumni who surrounded it throughout the day testified to the fact that the nation's love affair with the automobile is by no means over; it's just that our concept of beauty is changing.

Professor Heywood thinks Detroit will concentrate during the next decade on the middle-size range, where "existing technology can be surprisingly improved" in terms of economy and quality. Indeed, the U.S. may leave to others the task of making tomorrow's smallest cars; Dr. Whitman told the symposium that U.S. automakers may turn increasingly to overseas production for their lowest-cost lines.

The New Era of International Competition

The rest of the present century will be a period of intense international competition in automaking, with a shake-out among international makers resembling the shake-out that took so many famous names—Hudson, Duesenberg, Graham-Paige, Pierce Arrow, Packard, and all the rest—off U.S. nameplates in the middle of this century. By 1990, said Dr. Whitman, perhaps only six or eight international producers will be responsible for all the world's cars. (But Dr. Whitman warned her audience of the hazards of such a prediction: talking about the future of the automobile industry today is like "trying to make a long-range weather forecast in the middle of a hurricane.")

Among U.S. assets in the coming international showdown is the "enormous data base" represented by the U.S. industry's experience in building billions of vehicles. The Japanese have been drawing on it: "Everything they know they learned here in America," said James W. McLernon, president of Volkswagen of America, Inc.; "they just refined it and did a better job of it." After its own review of Japanese auto plants, General Motors agrees: "They enjoy no special technological tools or systems," said Mr. Kehrl.

There's still a lot to be learned about the automobile; indeed, "it's astonishing how little we know about what goes on in an automobile engine," said Professor Heywood, so there's lots of room for improvement. Mr. Kehrl seemed more confident: "the technical tools needed to improve our efficiency and quality are well understood," he declared, citing several General Motors developments in robotics and other manufacturing technologies. But both agreed that cars of the future will be far more sophisticated that those of the past—and even of the present. "Within the next several years," said Mr. Kehrl, "the auto industry will have changed from a medium-technology to a high-technology enterprise."

Photos: Bradford Herzog

Photos: James J. Snyder, '61

65th Reunion Clambake: Warm Good Nature and Delight in Problem Solving

Ralph Fletcher, '16, president and acting secretary, stood to give a prayer before the clambake luncheon of the 65th Reunion at Endicott House:

"A silent prayer to our classmates who have departed us and to those who are still amongst us," he said.

A sumptuous clambake began, then: clam chowder, steamed clams with butter, corn, lobsters, and a lime chiffon pie, all accompanied by white wine.

Ralph Fletcher sat on my right, Mrs. Fletcher on my left. Mr. Fletcher was telling me he was track team general manager and graduated with the class of '16, although when he came to M.I.T., he was to graduate with the class of '17. He said that he feels there should be a statue of a beaver in Killian Court, more than life size. "The beaver is a symbol and we don't have it on campus . . . The place could use dressing up—it never was properly adorned," he added. "Years ago I could have raised the money, but my classmates are all dead and gone, and the rich ones are all dead."

"Since 1945, we've had a reunion every year," said Mrs. Fletcher.

Other voices at the table filter through above the gentle din:

"What about your nap?"

"I'm asleep all the time, I can sleep with my eyes open."

"I'm afraid if they don't take a nap they'll be asleep at the Pops."

Someone was describing Paris on Christmas eve: "We started eating at midnight, and didn't stop eating till dawn."

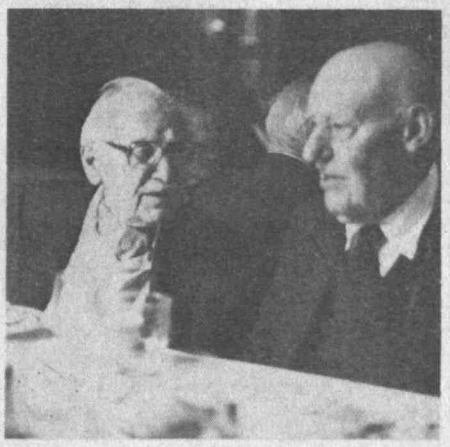
There was discussion of clothes, the heat, travels, jobs.

"I never really worked for a living—it seemed I was paid to have a lot of fun in my career," said one chemical engineer. "The creative end of anything is important *and* fun," he counseled. "My classmates in 1916 thought working for oil companies was the way to make money. But I had a feeling for research, so I went into the creative end (to the dismay of some of my friends). Yet my inventions have made fortunes for the two companies I worked for—and I made money too."

The traditional red jackets were explained to me—only M.I.T. alumni graduated more than 50 years ago can wear them. They were an innovation by the Class of '16 for its 50th reunion.

They reminisced about school. And about the problems and professors.

"When I think of the things I can't remember it's annoying. But that's no



reason your children should push you around. My son and I have switched roles—he tells me what to do. He's 63."

"It's a wonderful magazine, I've been reading it for 60 years."

"If you nap, can you sleep all night?"

"I can't do what I used to—tomorrow I'll be wondering what your name is."

The permeating sensation throughout the slow pace of a sultry summer day was their warm good nature toward each other, their enjoyment of life, and their continuing delight in solving puzzles and math and engineering problems.—*M.L.*

In Tribute to "a Singular Fellowship . . . a Quality of Caring"

Following is the text of the address by James R. Killian, Jr., '26, at the Technology Day Memorial Service in memory of 567 alumni reported deceased during the preceding year.

This is a moment of homage as well as a testament of bereavement. For me it is a privileged opportunity to express the pride and admiration I feel for those we memorialize today and for the overall body of M.I.T. graduates from which they have been lost.

My association with the Institute for nearly six decades has afforded me an almost unique opportunity to know a vast number of our graduates, including many who have passed away. This experience has convinced me that a brusque reticence characterizes our corporate fellowship and that this tends to leave unspoken, but not unfelt, a deep loyalty and pride.

Student life at M.I.T., with its professional orientation, its intense work ethic, and its high standards, does not lead to the superficial rah-rah spirit present in some institutions. It does bring about a singular fellowship that I have come greatly to admire as a distinctive asset and hallmark of our institution.

There are other reasons to pay homage to our alumni, past and present. They have constituted a significant fraction of the leadership and strength of our country. By their professional qualities and their attribute of caring, they have contributed to the high purposes and the quality of our society. Some have spent their careers on the great highways directing large enterprises or helping to shape the destiny of institutions or, by their vision, to bring about an enlargement of life for their families, comrades, and associates. Others have lived and worked on the quiet byways, but through their personal distinction, their integrity, and their dedication to community service, they have constituted the very sinews and substance of our society.

Among the deceased we honor today we find exemplifications of these varieties of the contributing life, and these qualities give us reasons to speak of them with pride and gratitude as cherished sons and daughters of M.I.T.

The Quality of Caring

Let me speak for a moment of the quality of caring that has been the hallmark of so many of our alumni. To turn to the past, I think of Alfred Sloan and how he created the Sloan-Kettering Institute for Cancer Research and the Sloan Foundation while making his great donations to M.I.T. I think of our alumna, Mrs. Stanley McCormick, and her farseeing contributions to population control. In her will, in which she named M.I.T. as her residual beneficiary, she included a gracious statement about her special interest in the Institute. "Since my graduation in 1904," she wrote, "I wished to express my gratitude to the Institute for its advanced policy of scientific education for women."

I think of two present members of our Corporation, Cecil and Ida Green, husband and wife, who have generously supported learning and research in this country and overseas, motivated by a sustained desire to make the world a better place to live in. And finally, I think of two other Corporation members, the late Uncas Whitaker and now his wife Helen, who together have advanced the growth of health sciences at the Institute.

In the list of those lost to us during the past year are the names of two great pioneers of America's preeminent aircraft industry—Donald Douglas and James McDonnell, Jr. The great company founded by Douglas designed and built many great aircraft, notably among them the famous DC-3, one of the most successful and widely used aircraft in the history of aeronautics. James McDonnell founded the McDonnell Aircraft Co., another builder of advanced military aircraft and great transportation planes. The tides of corporate change ultimately led to the merger of the Douglas and McDonnell companies, thus bringing together two institutions founded by these two M.I.T. alumni.

I recall an anecdote Donald Douglas once told about himself. While a student at M.I.T., he was appointed an assistant to Professor Jerome Hunsaker, who was then introducing teaching and research in aerodynamics at the Institute. One evening, as Douglas told the story, Hunsaker had fortuitously seen him at a student celebration at what M.I.T. students in the Rogers Building once called "The Chapel" located in a hotel on Boylston Street. The morning after, Douglas inadvertently broke a delicate balance which Hunsaker had brought from England to use in the first academic air research tunnel in the United States. In a spirit of contriteness Douglas went to Professor Hunsaker and submitted his resignation, saying that the accident to the balance might not have happened if he had not celebrated so uninhibitedly the night before. Hunsaker brusquely ordered him back to work to repair the balance and continue the research. Had Hunsaker accepted his resignation, concluded Douglas, he probably would have wound up in an

". . . a continuum of strong bonds of association, of high purpose, and of the love of persons," said Robert J. Holden, associate dean for student affairs, describing the mood of the memorial service on Technology Day. The address in which James R. Killian, Jr. '26 (photo, left) expressed his own "pride and admiration" for M.I.T. and its alumni is reproduced on these pages, and the remarks of Melissa R. Teixeira, '44, are condensed on the next page. (Photo: Calvin Campbell)

entirely different kind of career.

I recall the quality of caring being demonstrated when a student at M.I.T. suffered an accident which forced him to remain in the Infirmary for an extended period. While he was thus kept away from his classes, a young instructor showed up volunteering to tutor him on the part of the course he was missing. The alumnus who proudly recalled this experience said that the name of the instructor who tutored him was Paul Gray. This alumnus told me the story when we encountered each other unexpectedly a month or so ago in Washington.

I recall still another example of this spirit of caring at the Institute. In 1955, my wife was disabled by a stroke and for a period was confronted with learning to walk again. The then-president of the Alumni Association came to me to report that a group of alumni had volunteered to raise funds for the installation of an elevator in the President's House. The name of this alumnus was Dwight Arnold, who in so many ways contributed to the welfare of the Institute as alumni officer and Corporation member. He is among those we honor today.

An Interactive Fellowship

This memorial service holds special meaning for those of us in the Class of 1926, who forgather for our 55th reunion this weekend. In this single year of accounting, the bell tolled for 18 of 1926 who will not be present. At our reunion, however, we will be paying special tribute to one member of the class who occupies a place in the hearts of us all and whom we hold in affectionate veneration. For nearly a quarter of a century this rare person, George Warren Smith, served as our class secretary and by his regular and comprehensive class notes kept the members of our class in touch with each other in a way that enabled us to become members of an interactive fellowship that gave character and friendly coherence to the class.

George loved the sea, and his enthusiasm for sailing led him a decade ago to volunteer to raise funds to refurbish M.I.T.'s sailing pavillion and to commission the building of a new fleet of dinghies. Quietly and with telling success, he and his volunteer committee raised over $300,000. He possessed, too, the quality of caring about which I have spoken and was a beloved contributor to the fellowship that brings together the sons and daughters of M.I.T.

The distinguished British economist and editor, Walter Bagehot, once observed that nations may at last fail from not comprehending the great institutions they have created. For that and many other reasons M.I.T. warrants the fullest comprehension, and this memorial service furthers that comprehension. M.I.T. has grown to greatness most noticeably in the student years of those we memorialize today, and the rank and file of our achieving and loyal alumni altogether has been one of the evidences of its becoming a renowned insitution. We acknowledge today the collective achievement of their lives as they demonstrated the highest aims and purposes of the Institute. By their good works they remain as members of that great society which Wordsworth described as consisting of the noble living together with the noble dead.

It was another poet, Stephen Spender, who summed it up:

I think continually of . . .
The names of those who in their lives fought for life,
Who wore at their hearts the fire's center.
Born of the sun they traveled a short while toward the sun,
And left the vivid air signed with their honour.

It is a privilege for me to say these words in the presence of the families and friends of those to whom this memorial service is dedicated.

". . . the Joy of Discovery"

Among the recollections of alumni by Melissa Wood Teixeira, '44, at the Memorial Service on Technology Day, June 5 (Mrs. Teixeira's husband, the late Newton A. Teixeira, '44, was among those memoralized by the service):

In most cases it was his approach to life which attracted him to M.I.T. He was not content to scratch only the surface of life. He wanted to dig deeper into its order and its mysteries. He found he needed to know how things related to one another, particularly after he had seemingly devoted his attention to one small detail. . . . He was constantly trying to place each discovery in its proper order of things. As time passed, order became acceptable and the mysteries deepened.

Each organization and each individual who met or worked with him became influenced and impressed by him, his attention to detail, and his devotion to the tasks he accepted. He was a teacher.

If he took an active role in alumni activities, he was continually impressed by today's students: they were more involved in life around them than he had been as a student.

He loved his fellow man and tried to make life better for him and himself. He was continually concerned with man's seeming preoccupation to destroy himself and his world and did what he could to stop the trend.

He delighted in the discovery, and later the observance, of the beginnings of life. . . . He spent many free hours reading. . . . Among others, his library contained books on philosophy and religion, management, science and psychology . . . languages which had been learned and others to be learned in the future.

He gave me many things in life and helped me appreciate knowledge, find the joy of discovery, know the depth of friendship, and enjoy life itself.

It was a reunion for Dr. Carola Eisenberg, too: she's now dean of students at Harvard Medical School, but she came back on June 5 to be greeted by Gary Duke Speer, '76, who made Carola (she was dean for student affairs at M.I.T. from 1972 to 1978) an honorary member of the class. (Photo: Gordon R. Haff, '79)

The bicycles he rode at M.I.T. 50 years ago never looked like this. But with help from Professor David Gordon Wilson (left), the "old grads" caught on fast enough to the trick of riding a recumbent two-wheeler. It was all publicity for Velocity Group, the M.I.T. students who are building a human-powered vehicle to challenge the world speed record (see pages A 16-17). Photo: Bradford Herzog

Courses

Professor Hayrettin Kardestuncer, S.M.'75, and his family will return to the University of Connecticut this fall after serving as guest on the faculties of several Chinese Universities. Ms. Kardestuncer (left) is completing research on a doctoral dissertation on Turkic languages spoken in Xinjiang Province, and the three children—Rana (10), Tarkik (12), and Erik (15)—have been learning Chinese as students in the public schools.

I
Civil Engineering

Hayrettin Kardestuncer, S.M.'57, reports from Hefei Polytechnical University, Hefei, Anjui, in the Peoples Republic of China, that he was the principal organizer of the First Invitational Finite Element Symposium at the university at the end of May; 300 invited Chinese engineers and scientists attended, and Professor Theodore H. Pian, Sc.D.'48, of the M.I.T. Department of Aeronautics and Astronautics, who has made pioneering contributions to the field, was guest of honor.

T. William Lambe, Sc.D.'48, retired as Edmund K. Turner Professor of Civil Engineering at the end of the 1980-81 academic year, culminating a 36-year career on the M.I.T. faculty. During that period he has been a major contributor to the science and practice of soil mechanics in such geotechnical subjects as foundations and underground construction, soil technology, and soil stabilization. A conference to review these contributions and future developments in this geotechnical field will be held in Professor Lambe's honor at M.I.T. next September 24 and 25.

Professor Lambe came to M.I.T. in 1943 for graduate study from North Carolina State University, and he joined the faculty one year after receiving his doctorate from the Institute. He assumed the Edmund K. Turner chair in 1969 when it was founded to honor one of the department's first graduates. Professor Lambe has been engaged in major engineering projects throughout the U.S. and in Venezuela, Iraq, Jamaica, Turkey, Libya, Jordan, Holland, and Japan. He has lectured in a number of countries, including a Terzaghi Memorial Lecture in Istanbul in 1973 and the Terzaghi Lecture for the American Society of Civil Engineers in 1970.

Stanley White, S.M.'76,writes, "The small consulting firm that I am associated with, Han-Padron Associates, is growing. We are currently in a joint venture with a construction company on the design/construction of a coal transfer facility south of New Orleans. HPA is doing all engineering and I am project manager." . . . **Francois Rollin,** S.M.'79, writes that he is currently working in France (Normandy) as a project manager for Esso S.A.F., the French subsidiary of Exxon, involved in construction projects related to unit modernization and storage facility extension at the refinery of Port Jerome. . . . **Dennis A. Roth,** S.M.'72, has been presented the 1981 Pittsburgh Young Civil Engineer Award as the "outstanding young civil engineer of the year" by the Pittsburgh section of the American Society of Civil Engineers. . . . **Edward B. Kinner,** Sc.D.'70, has been promoted from project engineer to a principal, director, and senior vice-president of the firm of Haley & Aldrich, Inc., Cambridge, Mass. . . . **Joseph J. Rixner,** S.M.'68, former associate and vice-president of Haley & Aldrich, has been appointed manager of its affiliate firm, H&A of Rochester, New York. . . . **Austin W. Betts,** S.M.'38, senior vice-president, Southwest Research Institute, was presented the Institute of Environmental Sciences Monroe Seligman Award for his contributions toward the furthering of the purposes of the Institute.

II
Mechanical Engineering

William T. Hogan, Sc.D.'59, who has been first vice-president for academic affairs since 1977 of the University of Lowell, Mass., has been named president, effective June 1, 1981. . . . **Richard L. Schapker,** S.M.'57, founder and principal consultant of S2 Corp., Haverhill, Mass., has been elected president of Northern Essex Community College Foundation. . . . **Nicholas R. Tomassetti,** S.M.'58, has been appointed vice-president of marketing and customer support of the Commercial Products Division of United Technologies Pratt and Whitney Aircraft, East Hartford, Conn., responsible for the Middle East, Africa, and India. . . . **Abdulkerim Kar,** Ph.D.'80, has been appointed assistant professor of mechanical engineering at Istanbul Technical University.

Jon A. Andresen, S.M.'73, has been promoted to systems engineer in the Engineering Department of Southern Pacific Transportation Co. . . . **Robert G. Bowie,** '38, of Rochester, N.Y., retired director of government and education markets of Eastman Kodak Co., died on April 2, 1981, while vacationing in the Apache National Forest, N. Mex.

III
Materials Science and Engineering

Alan Bleier, assistant professor of ceramics, has been designated to hold the Corning Glass Assistant Professorship, the result of a Corning Glass Works grant to support M.I.T. work bridging the sciences of ceramics processing and colloid chemistry. The link between the fields—the formation and properties of fine particulates—is one key issue in a new Ceramics Processing Research Laboratory at M.I.T. in which Professor Bleier will work. . . . **Hugo R. Larson,** Sc.D.'51, director of metallurgical research at Abex Corp., Mahwah, N.J., has been named a 1981 recipient of the Award of Merit by ASTM, cited for research in the advancement of voluntary standardization in test methods and specifications for iron castings. . . . **Lisa C. Klein,** Ph.D.'77, has been promoted to associate professor of ceramic science and engineering, with tenure, at Rutgers University and is involved in research on glass, glass-ceramics, and sol-gel technology.

IV
Architecture

Charles B. Thomsen, M.Arch.'63, former executive vice-president and chief development officer, has

Congratulations to the new Corning Assistant Professor, Alan Bleier (right) of Materials Science and Engineering from John R. Hutchins, III, Ph.D.'59, vice-president and director of research at Corning Glass Works. (Photo: Calvin Campbell)

T.W. Lambe

Symposium for Lambe

"Geotechnical Engineering—Past, Present, and Future" is the title of a two-day symposium in honor of Professor T. William Lambe, Sc.D. '48, scheduled for September 24 and 25, and all alumni of the Department of Civil Engineering—and others interested in the subject—are invited.

Professor Lambe, who joined the faculty of the department in 1945, retired last July 1 after a distinguished career in teaching and research in the field. The symposium will include a summary of Professor Lambe's own work as well as papers on future research and practice in the field. For further information: Professor Robert V. Whitman, Sc.D. '51, Room 1-380, M.I.T., or 617/253-7127.

been named president and chief executive officer of CRS Group, Inc., a Houston, Tex., construction concern. . . . **Bernard Jensen,** M.Arch.'58, has joined the San Francisco, Calif., office of Hellmuth, Obata and Kassabaum, Inc., Architects, Engineers, Planners, and Associates. . . . **Isabel King Bradshaw,** M.Arch.'72, writes, "In the last year, I have opened my own office, the Bradshaw Architects, and have four employees." . . . **David Jeremiah Hurley,** M.Arch.'53, recently won a Citation of Merit in the 1981 Innovations in Housing national residential design competition. His entry, described as "on the leading edge of single-family home design, used a unique concept of external thermal shutters coupled with insulated glass panels and light control blinds for passive solar heating."

James W. Partlow, M.Arch.'73, is presently an associate with Falick/Klein Partnership, Houston, Tex., an architectural firm. . . . **Thomas L. Hansen,** M.Arch.'39, professor emeritus of the University of Colorado School of Environmental Design, passed away in Denver, Colo., on April 1, 1981. He was appointed head of the Department of Architecture and Architectural Engineering at the university in 1952, and also taught at the Overseas Education Institute in Grenoble, France, Washington State University, North Dakota State University, and the University of Washington.

V
Chemistry

Professor David N. Hume, who taught analytical chemistry at M.I.T. since 1947, retired at the end of the 1980-81 academic year. In just under 35 years of active teaching, Professor Hume has guided nearly 50 students to Ph.D. degrees, and he has published over 135 technical papers in electrochemistry, environmental trace analysis, statistical methods, and complex-ion equilibria.

Following graduation from the University of Minnesota (Ph.D. 1943), Professor Hume joined the Manhattan Project at the University of Chicago and later worked also at the Clinton Laboratories, Oak Ridge, Tenn., where he was in charge of research groups studying the analytical chemistry of plutonium and other fission products. He holds the Fisher Award in analytical chemistry of the American Chemical Society, and he's taught as a visiting lecturer or fellow at the Technical Univeristy of Denmark, the Swiss Federal Institute of Technology, the Royal (Swedish) Institute of Technology, and the Woods Hole Oceanographic Institution.

Stefan Unger, Ph.D.'71, writes that he has organized the 1981 Gordon Research Conference, "Quantitative Structure Activity Relationships," dealing with many facets of computerized drug design. . . . **J. Stuart Fordyce,** Ph.D.'59, reports that he has been appointed acting chief, Solar Electrochemistry Division, NASA Lewis Research Center on July 1, 1981. Prior to this appointment, he has been deputy chief (for 18 months) and chief of the Electrochemistry Branch at NASA since 1966. . . . **J. Throck Watson,** Ph.D.'65, has been awarded the Citation of Merit by Iowa State University's College of Sciences and Humanities. The citation is awarded to the most distinguished alumnus or alumna who received a bachelor's degree from the college at least 20 years prior to nomination for the award and has demonstrated outstanding achievement and national or international reputation in his or her area of endeavor.

Frank Vellaccio, Ph.D.'74, a faculty member since 1974 at Holy Cross College, has been promoted to the rank of associate professor, with tenure. . . . **Maryalice C. Moore,** Ph.D.'43, professor of chemistry and chairwoman of the department for 18 years at Stonehill College, Easton, Mass., has been awarded an honorary degree from the college at its 1981 Commencement Exercises. . . . **George Lukas,** Ph.D.'63, has been appointed director of pharmaceutics and pharmaceutical technology for the Pharmaceutical Division of CIBA-GEIGY, Summit, N.J. He joined the firm in 1964 and has held several positions of increasing responsibility. . . . **Warren N. Baxter,** Ph.D.'53, of Houston, Tex., passed away on November 9, 1980. . . . **Dewey J. Sandell, Jr.,** Ph.D.'49, former vice-president of Carrier Corp., Syracuse, N.Y., died on March 8, 1981.

VI
Electrical Engineering and Computer Science

Two awards for his service to the department came to **John A. Tucker,** director of Course VI-A, this spring:

☐ M.I.T.'s Gordon Y. Billard Award in recognition of "exemplary service." The citation noted Mr. Tucker's success as "perpetual enhancer of student-faculty relations . . . and warm friend to everyone whose path you cross, wherever located and of whatever age. You have striven unflaggingly to make your department and M.I.T. memorable for each of us in not only intellectual but also emotional terms," said the citation signed by President Paul E. Gray, '54.

☐ A special service award of Tau Beta Pi, the national engineering honor society, "in grateful appreciation for his 25 years of outstanding service as adviser to the Massachusetts Beta (M.I.T.) Chapter."

Two members of the department faculty, Professors **Gerald P. Dinneen** and **John M. Wozencraft,** Sc.D.'57, retired during the 1980-81 academic year. Dr. Dinneen was principally associated with Lincoln Laboratory during his M.I.T. career, having come there as a staff member in the Data Transmission Group in 1953. By 1966 he was associate director of the laboratory; he became its director in 1970 and in 1977 resigned to accept the post of assistant secretary for research and development of the Air Force in Washington while continuing (on leave) his association with the M.I.T. faculty.

Professor Wozencraft, a specialist in computer science and communication theory, came to M.I.T. as a graduate student in 1950 and joined the faculty in 1957 upon completion of his doctorate.

To Assistant Professor **Erich P. Ippen,** '62 (with Charles V. Shank of Bell Laboratories), the $1,000 R.W. Wood Prize of the Optical Society of America for pioneering work in high-speed spectroscopy and its application to studies of semiconductors and biological materials. . . . **Wilbur B. Davenport,** Sc.D.'43, Professor of Communications Science and Engineering has received the 1981 Pioneer Award bestowed by Aerospace and Electronic Systems Society for his contributions in the development of spread spectrum communications. . . . **Thomas F. Jones,** Sc.D.'40, Vice-President for Research at M.I.T., has been elected vice-president of public affairs of the American Society for Engineering Education.

Robert E. Lee, S.M.'68, has joined Computer Sciences, Inc., as a finance consultant associated with its Infonet Division, New York City. . . . **Paul J. Shaver,** Sc.D.'62, has recently been elected president of Xciton Corp., Latham, N.Y., manufacturer of solid state light sources. . . . **Joseph Bordogna,** S.M.'60, a teacher and administrator at the University of Pennsylvania for the past 17 years, has been appointed dean of the School of Engineering and Applied Science. . . . **J. Kenneth Watson,** S.M.'55, writes, "I am on sabbatical leave from the University of Florida for nine months, and I'm visiting professor of electrical engineering at the California Institute of Technology, affiliated with the Power Electronics Group." . . . **Edward E. David, Jr.,** Sc.D.'47, president of Exxon Research and Engineering Co., and former science adviser to the President, has been elected a trustee of the University of Rochester. . . . **James R. Melcher,** Ph.D.'62, has recently written *Continuum Electromechanics* published by the M.I.T. Press, Cambridge, Mass. . . . **Peter G. Jessel,** Ph.D.'72, has joined Integral Data Systems, Inc., Milford, N.H., as vice-president of engineering.

David I. Konsowsky, Sc.D.'52, is currenty president of Damon Corp., Needham, Mass. The firm is making a bid to become "a total broad-spectrum company in biotechnology" with the creation of a new subsidiary, Damon Biotech, Inc., focusing on development of interferon, monoclonal antibodies,

cancer diagnostics and vaccines. . . . **Nelson E. Bolen,** S.M.'60, has been promoted from department head of Information Distribution Systems to associate technical director at MITRE Corp., Bedford, Mass.

VI-A Program

Ninety-four new students began their affiliation with the VI-A program in June, the majority of them heading out for their first company assignments this summer. The largest number of students, ever, applied for VI-A, 195; and 152 of these appeared on the company preference lists. Unfortunately, as reported in the April issue, the department had to limit the size of the program by restricting the number of new students allowed to join (approximately 85) in each of the next three years. Unfortunate, too, is that many, many companies expressing a desire to join the program have had to be told of the current limitation. This was the first year that some of the participating companies could not have as many new students as they wished.

Technology Day, June 5th, found a number of VI-A alumni visiting the VI-A Office; **Robert J. Caldwell,** '36, chairman and chief executive officer of California Products Corp.; **Michael L. Harvey,** '72 with Booz, Allen and Hamilton; **Henry C. Johnson,** '36; **H. DuBose Montgomery,** '71, managing director of Menlo Venture Capital; **Lawrence G. Peterson,** '36, retired; **Roger E. Robertson,** '41, retired; **Jack L. Rosenfeld,** '56, a member of the research staff at IBM's Watson Laboratories; **Andrew J. Viterbi,** '56, executive vice-president of Linkabit Corp.; and **Stanley E. Webber,** '41, president of Litton Industries.

Among those VI-As celebrating their 50th reunion who met Director Tucker were: **Albert E. Coleman,** '31; **Harold J. Davis,** '31; **Arthur C. Donovan,** '31; **Howard L. Richardson,** '31, class president; and **Donald B. Sinclair,** '31, retired president of General Radio Co. These, and others, also attended the groundbreaking ceremonies for the new E.G. & G. Education Center to be constructed between Buildings 24, 36 and 38 for occupancy by October 1982.

Seen at the Technology Day luncheon were **William E. Northfield,** '56, president of Computer Devices, Inc., and **Walter C. Kinzinger,** '51. Walt's son, Arthur W., '83, is in this year's new VI-A class, and he has a younger brother who was in this year's freshman class.

Michael L. Bushnell, '74 is with Applicon, Inc. He came in and talked with Mr. Tucker in April and has decided to pursue a master's degree in computer science at Carnegie-Mellon starting in the fall. We wish him luck in this endeavor.

A number of VI-As attended M.I.T.'s Spring 1981 VLSI Research Review Conference on May 18: Professor **Richard B. Adler,** '43, **James J. Cherry,** '78, **Mark T. Fuccio,** '80, **David M. Goddeau,** '79, **Brian D. Hamilton,** '79, **John C.L. Hou,** '81, **Edward W. Maby,** '74, **Peter M. Osterberg,** '78, **John J. Paulos,** '79, and **Richard S. Withers,** '75.

This June five of our VI-As received Ph.D.s; congratulations to **George M. Blaszcynski,** '71, **Geoffrey J. Bunza,** '74, **Mark F. Davis,** '69, **Donald S. Levinstone,** '72, and **Arthur V. Radun,** '77. Dr. Bunza has joined GenRad and Dr. Radun has joined his VI-A company, General Electric/Pittsfield. A Ph.D. celebration party for Geoff was held at the home of **Bradford E. Hampson,** '75 in Framingham, Mass. Other VI-As attending included **Steven L. Bates,** '74, **Lawrence Kernan,** '75, **Gordon M. Ueki,** '77, and Director Tucker.

Others whose name appear in the VI-A Visitors Book since last writing and are not mentioned above include: **Thomas H. Crystal,** '59 (and son Michael), on the research staff of IDA; **Leonard N. Evenchik,** '77, with Bolt Beranek and Newman; **Craig E. Goldman,** '80, with PR1ME Computer; **Jeffrey J. Held,** '76, staff consultant for Network Strategies; **Steven D. Krueger,** '80, with Texas Instruments; **Philip O. Martel,** '71, with General Electric/Pittsfield; **Kenneth A. Parulski,** '79, with Kodak Research Laboratories; **Shahram Shirazi,** '75, with Bain and Co.; and **Kevin D. Stoddart,** '71, with Watkins-Johnson.

Attending a meeting with Mr. Tucker at Hewlett-Packard's Waltham Division was **Thomas C. Horth,** '57, representing Hewlett-Packard's Andover Division. While there Director Tucker ran into **Paul R. Skar,** '78, who is employed at the Waltham Division.

It is with great sadness we report the death, last April, of Professor Marcy Eager. Professor Eager joined the M.I.T. faculty following World War II, during which time he had been affiliated with the M.I.T. Radar School. In 1954 he joined the VI-A Office under, then, VI-A Director Professor **Eugene W. Boehne,** '28, and he served as assistant in that office until his retirement in 1963. Many, I know, will remember Professor Eager's counsel and sincere interest in VI-A students.

Lastly, **Frank T. DeWolf,** '40, writes that he retired June 1 from General Electric where he began as a VI-A student. His new address is: 2305 Cass St., Sarasota, FL 33581. We hope he enjoys a well earned retirement!

May I also use this forum to thank all those who wrote in support of my receiving M.I.T.'s prestigious Billard Award (*see the Course VI notes above*) this spring. It was a great honor for me and for my 12 years as director of the VI-A program.

Thanks, too, to many VI-A alumni/ae who have said how much they appreciate these reports. If you have news, please send it into the the VI-A Office for us to pass along.—John A. Tucker, VI-A Office, Room 38-473, M.I.T., Cambridge, MA 02139.

VII
Biology

David Bostein, Professor of Genetics in the department at M.I.T., has been elected a member to the National Academy of Sciences. . . . **Cecily Cannan Selby,** Ph.D.'50, dean for academic affairs at the North Carolina School of Science and Mathematics, Durham, and former headmistress of the Lenox School, New York City, was married on February 22, 1981, to James S. Coles, former president of Bowdoin College who is now president of the Research Corp., New York City. . . . **Linda L. Spremulli,** Ph.D.'73, has been promoted to associate professor of chemistry, with tenure, at the University of North Carolina. . . . **Emanuel Goldman,** Ph.D.'72, writes, "I am currently assistant professor of microbiology at New Jersey Medical School, have received the 1980 Faculty Exceptional Merit Award, and was runner-up for the 1981 Graduate Student Association Distinguished Scientist Award. I still dabble in film criticism from time to time." . . . **George J. Coogan,** '39, chairman of the Everett, Mass., Board of Assessors and former director of the Massachusetts Division of Water Supply, passed away on April 5, 1981. A lifelong resident of Everett, he served 30 years on the Board of Assessors and retired as director of the Division of Water Supply, supervising all water supplies in Massachusetts, in 1980. During his career he was honored with the George Warren Fuller Award as the water utility's Man of the Year, and with the Dexter Brackett medal from the New England Water Works Association for his 36 years of service to the state.

VIII
Physics

George Bernard Benedek, Alfred H. Caspary Professor of Physics and Biological Physics in the department at M.I.T., has been elected a member to the National Academy of Sciences. . . . **Priscilla J. Benson,** S.M.'79, and Jacqueline Hewitt, both doctoral candidates in the department, have been awarded Amelia Earhart Fellowships by Zonta International Service Organization of Executive Women in Business and the Professions. Ms. Benson, who also held an Earhart fellowship last year, is taking courses in astrophysics and doing research in radio astronomy; and Ms. Hewitt is working in cosmology. . . . **Cyril Harris,** Ph.D.'45, professor of architecture and electrical engineering at Columbia University was awarded an honorary degree by the New Jersey Institute of Technology at its 1981 Commencement Exercises in recognition of his work in acoustics. His work is applauded in concert halls throughout the world: the John F. Kennedy Center for Performing Arts and the Metropolitan Opera House and Avery Fisher Hall at Lincoln Center.

Jonathan Allen Heads RLE

Professor Jonathan Allen, Ph.D.'68, whose research is in the areas of speech processing, computational linguistics, computer architecture, and integrated electronics, is now director of the Research Laboratory for Electronics. He succeeds Professor Peter A. Wolff, who last spring became director of the Francis Bitter National Magnet Laboratory.

Professor Allen is a member of the Department of Electrical Engineering and Computer Science, and he served under Professor Wolff as associate director of RLE, where he correlated the activities in engineering and communications. His special tasks were to interface hardware and software programs in RLE and to strengthen ties between RLE's engineering and linguistics groups.

Professor Allen came to M.I.T. for graduate study after receiving bachelor's and master's degrees from Dartmouth. At Bell Telephone Laboratories from 1962 to 1968, he was involved with the design of telephone information and vocodor systems. Since then, at M.I.T., his research has been on speech recognition and conversion systems.

X
Chemical Engineering

J. Bert Bunnell, Sc.D.'72, writes, "I have recently started a new company, Bunnell Life Systems, Inc., to develop and manufacture medical life support equipment. I am presently serving as president and chairman of the board." . . . **Michel L. Besson,** S.M.'60, president and chief executive officer of CertainTeed Corp., has been elected a director of Fidelcor, Inc., Rosemont, Penn., a bank holding firm. . . . **Robert D. Anding,** S.M.'49, president and director of Essochem Europe, Inc., has been named president of Exxon Chemical Americas, Houston, Tex., effective on August 1, 1981.

Robert B. Flanders, S.M.'58, reports, "Still doing my thing as senior applications engineer at NRC, Inc. Best job I had in 43 years. Just turned 65—hope to keep going until 75?" . . . **Brian Mead,** S.M.'22, a retired engineer with Exxon, passed away on January 3, 1981. . . . **Rex Shanks, Jr.,** S.M.'49, a chemical engineer in the marketing department with the Exxon Company U.S.A., Houston, Tex., and a member of the American Institute of Chemical Engineers and the American Chemical Society, passed away on June 1, 1981; he had been with Exxon since graduating and was deeply devoted to his avocation of symphonic and piano music. He was an engineering graduate—class of 1947—of Texas A&M University and served in the United States Army from 1944 to 1947. . . . **Frank S. Bonham, Jr.,** S.M.'41, of Chesterfield, Mo., passed away on January 8, 1981; details are not available.

XI
Urban Studies and Planning

Richard Conway, S.M.'57, was appointed corporate development fellow by Union Carbide Corp. in March 1981. . . . **Richard L. Schulze,** M.C.P.'70, was appointed vice-president and counsel for development of the Hyatt Corp., Rosemont, Ill., a hotel management concern. . . . **David Mann,** M.C.P.'67, previously chief staff planner for neighborhoods, has been named Hartford's (Conn.) Deputy Director of Planning. . . . **Stewart G. Green,** S.M.'47, of Seattle, Wash., passed away on December 8, 1980.

XII
Earth and Planetary Sciences

Professor **Frank Press,** who was on leave from his chair as Robert R. Shrock Professor Geophysics and Institute Professor from 1976 to 1980 to serve as science adviser to President Jimmy Carter and director of the White House Office of Science and Technology Policy, retired to the rank of professor emeritus coincident with becoming the 19th president of the National Academy of Sciences on July 1.

A graduate of the College of the City of New York (B.S. 1944) and Columbia (Ph.D. 1949), Dr. Press was a relatively late arrival at M.I.T.; before coming to Cambridge in 1965 he had been six years on the faculty at Columbia and ten years at California Institute of Technology, where for eight years he was director of the Seismological Laboratory. But at a reception in his honor last spring, Dr. Press was outspoken in his affection for M.I.T.: "This is my home institution," he said—"the place where I blossomed." And, he said, he wants to maintain "some sort of connection, to help out in any way I can."

Professor Press' scientific activities have been in seismology and the study of the interior of the earth, moon, and planets. Today observations of seismic surface waves and oscillations, which he first identified, are the most powerful techniques for the study of the structure and properties of the earth's crust and deep interior.

John Gille, Ph.D.'64, who currently heads the Global Observations, Modeling, and Optical Techniques Project at the National Center for Atmospheric Research. Boulder, Colo., has been elected a fellow of the American Meterological Society. . . . **Francisco Querol-Sune,** S.M.'68, reports, "After six-month leave working for a private company I have come back to the National University of Mexico as chairman of the Department of Geology and Geotechnics of the Division of Earth Sciences at the School of Engineering."

XIII
Ocean Engineering

Fendall Marbury, S.M.'52, writes that he now has a naval architectural practice in Chevy Chase, Md. His major activity is studies of ship operating speeds. . . . **Harold L. Young,** S.M.'60, commander of the Portsmouth (N.H.) Naval Shipyard, has been promoted to rear admiral; previous assignments have included submarine service and shipyard quality assurance.

On June 15, Captain **David V. Burke,** Ph.D.'72, relieved Captain **John H. Sweeney,** O.E.'60, as Commanding Officer of the NROTC and Administrative Unit at M.I.T. and head of the XIII-A Program in ceremonies held aboard the U.S.S. Constitution. At that time it was announced that the program, which has been in continuous operation since 1901, would have its first women officers. Among the 16 U.S.N. personnel starting the course this June were: Stephanie Lynne Coulter, Debra Lee Deacon, and Robin Lee Hiddeman.—John H. Sweeney, department head, Naval Science, M.I.T., Room 5-317, Cambridge, MA 02139.

XIV
Economics

Daniel Little McFadden, professor of in the department at M.I.T., has been elected a member of the National Academy of Sciences. . . . **George Shultz,** Ph.D.'49, is currently president of the Bechtel Group, Inc., a newly created holding company of the Bechtel Corp. . . . **David Belsley,** Ph.D.'65, professor of economics at Boston College and a visiting professor at M.I.T., has recently co-authored *Regression Diagnostics Identifying Influential Data and Sources of Colinearity,* published by John Wiley & Sons. This book provides the practicing statistician with new tools for assessing the quality and reliability of his regression estimates. . . . **Edward J. Kane,** Ph.D.'60, professor of finance and economics at Ohio State University, Columbus, has been elected to receive the first annual Pace Setter Outstanding Research Award and also received a 1981 University Distinguished Teaching Award. The Pace Award identifies the leading faculty member in the OSU College of Administrative Science.

XV
Management

John F. Collins, who served for eight years as mayor of Boston and then joined the M.I.T. faculty in 1968 to work with Professor Jay W. Forrester, S.M.'45, in the field of urban dynamics, retired during the 1980-81 academic year. He had recently been serving as consulting professor spending much of his time in a law practice in Boston. Professor Collins was influential in setting the direction of teaching in management, political science, and civil engineering during and after the years of the "urban crisis" of the 1970s.

Oswald Hake, S.M.'59, writes, "After 20 years in big industry (Phillips and GTE), I have now set up my own company, Dr. Hake & Parner GMBH, management consultants, specializing in serving U.S. companies setting up operations in Germany." . . . **Paul V. Cusick, Jr.,** S.M.'71, former vice-president and controller of BayBank Merrimack Valley, Mass., has been promoted to senior vice-president and controller. . . . **Robert Cayleff Weiss,** S.M.'74, joined Amerada Hess Corp. as assistant manager of corporate planning. . . . **Miles M. Harbur,** S.M.'77, has left Strategic Planning Associates in Washington, D.C., and joined Bain & Co. in Boston. . . . **Monique A. Plante,** S.M.'76, writes, "I am working as a senior sales representative at Corning Glass Works, Santa Clara, Calif., and am enjoying the heck out of selling. Hello Peter Lamb, Rich Horwitz, Professors Hax and Lanzenauer. Where are you, Harvey Berger?"

Donald C. Carroll, Ph.D.'58, dean of the Wharton School of Business of the University of Pennsylvania, has been elected a director of MacAndrews & Forbes Group, Inc., New York City. . . . **Donald C. Watters,** S.M.'67, has been named vice-president for finance, controller, and chief financial officer of the Dow Corning Corp., Midland, Mich. . . . **Eugene Solterno,** S.M.'66, has resigned from his position as president and chief executive officer of Moore McCormack Energy, Inc., Dallas, Tex., to set up his own oil and gas company. . . . **Thomas R. Williams,** S.M.'54, chairman and chief executive officer of the First Atlanta Corp., has been elected a director of Eastern Air Lines, Inc., Miami, Fla. . . . **Sidney B. Jeffreys,** S.M.'32, has been inducted into the Hall of Fame by the Greensboro (N.C.) Junior Achievement for his business leadership abilities. He is founder of the Jeffreys Engineering and Equipment Co., Greensboro, from which he retired in 1976 to work as a consultant in management and industrial engineering.

James A.F. Stoner, Ph.D.'67, writes, "I am completing a sabbatical from the Fordham Graduate School of Business where I am a professor and area coordinator (like a department chairman) for management. I am finishing a revision of my Prentice-Hall textbook in management, and recently returned from a working vacation in Brazil with my

wife (Dr. Barbara Stevens, '73). She vacationed and I taught in an executive program for the top management of the Brazilian subsidiary of a U.S. multinational. Have a wonderful new baby, Alexandra McLean Stevens, born December 16, 1979." . . . **William E. Cook,** S.M.'74, has been named president of Microsonics, Inc., manufacturers of frequency control products for radar and communications. . . . **Andre Deprez,** S.M.'55, reports, "I am now senior vice-president in charge of international sales and licensing of Scientifc Design Co., New York City, and am enjoying it, including the many trips to the Middle East, Southeast Asia, China, South America, and the rest . . . "

Robert E. Wall, S.M.'72, has opened his own accounting/financial consulting practice. . . . **Robert Norris,** S.M.'63, has joined the faculty of the Rudolf Steiner School, Great Barrington, Mass., as a first grade teacher. . . . . **Richard S. Bodman,** S.M.'61, president and chief executive officer of COMSAT General Corp., New Britain, Conn., has been elected a director of Emhart Corp.

Sloan Fellows

Robert L. Seaman, S.M.'68, vice-president, planning, of Raytheon Co., has been elected a director of Lukens Steel Co., Coatesville, Penn. . . . **George W. Anderson,** S.M.'73, has been named executive vice-president of Asarco, Inc., New York City. . . . **William P. Dugan,** S.M.'68, was elected a vice-president of Western Electric Co. and now heads its manufacturing-transmission division. He was previously general manager of Western Electric's Merrimack Valley Works. . . . **H. Robert Sharbaugh,** S.M.'61, a former chairman and chief executive officer of Sun Co., has been elected a director of Carpenter Technology Corp., Reading, Mass., a producer of specialty metals.

John H. Gerstenmaier, S.M.'52, former vice chairman of Goodyear Tire & Rubber Co., has been elected a director of Whirlpool Corp., Benton Harbor, Mich. . . . **Witt I. Langstaff,** '65, has been recently elected county commissioner in Sullivan County, Tenn. . . . **John D. White,** S.M.'71, has been named president of Galileo Electro-Optics Corp., Southbridge, Mass., and will also serve as chief executive officer and a director. . . . **Guy W. Nicholas,** S.M.'61, president and chief executive officer of New England Electric Systems Co., Westboro, Mass., received the honorary degree of doctor of engineering from Worcester Polytechnic Institute in its 1981 Commencement Exercises. . . . **James J. Ritchie,** S.M.'62, of Burlington, Vt., passed away on February 22, 1981.

Senior Executives

John H. Richardson, '59, president of Hughes Aircraft, Culver City, Calif., was recently given an M.I.T. Corporate Leadership Award.

XVI
Aeronautics and Astronautics

James K. Marstiller, S.M.'49, writes, "I am handling international activities for the U.S. Army's Remotely Piloted Vehicle Project Manager's Office. Just returned from a month in England, Germany, Austria and Switzerland, during which I gave a paper and chaired a session at the Second International RPV Conference in Bristol." . . . **John T. Olson,** S.M.'59, has been named commander of the Massachusetts Air National Guard's 102nd Fighter Interceptor Wing. He has served with the Air National Guard since 1956 and was most recently assigned as wing deputy commander for operations. . . . **Edwin N. Myers,** S.M.'61, is presently employed as a senior member, technical staff, at Eagle Research Group, Arlington, Va. He retired from federal civil service in 1980 where he was director, for electronics and physical sciences in the Office of the Secretary of Defense.

Benjamin Scovill Kelsey, S.M.'28, a retired Air Force brigadier general, passed away on March 3, 1981. His career, which spanned much of the aviation history in the United States, began in the days of wood and fabric biplanes and extending into the space age. In 1929 he joined the Army Air Corps; between 1934 and 1943 he was involved in the performance and functional testing of all fighters bought by the Corps; and in 1952 he was promoted to brigadier general and was made deputy director of research and development in the Office of the Air Force's Deputy Chief of Staff for Development, a post he held until his retirement in 1955. . . . **Richard L. Hayes,** '41, passed away on January 10, 1980; no details are available.

Never Underestimate the Power of a Sloan

Miffed when *Time* failed to include the Sloan School among top business schools in the U.S., Paula Cronin, S.M.'77, Sloan's director of placement, struck out: most of the criticisms levelled at business schools these days are just plain wrong, she told Robert Charm of the *Boston Globe.*

"You get through our program by working in small groups. People who get through Sloan successfully recognize the value of teamwork.

"The people we deal with have the credentials and motivation to succeed in business. They are not dreamers," she declared. "The admissions process tends to winnow out the person who has some fantasy about what the business world is all about. The ones we accept have a realistic view.

But it's also true that some master's students "are deluded into thinking a graduate degree will make them into something they are not. A business degree is a grafting on of a few more skills, some new jargon; but you are still the same person."

How about those big salaries for business school graduates? Starting salaries for the Sloan School's master's graduates in 1980 averaged $36,000, and they're a bit higher in 1981. That's high; but if business doesn't want Sloan School graduates, it doesn't have to pay those prices, says Ms. Cronin.

XVII
Political Science

John R. Mathiason, Ph.D.'68, is presently adjunct associate professor of public administration in the Graduate School of Public Administration of New York University. . . . **Andre B. Colpitts,** S.M.'74, of Owasso, Okla., passed away on May 21, 1976.

XVIII
Mathematics

Charles C. Conley, Ph.D.'61, is currently on a Humboldt Fellowship in Germany which began March 1981 and will terminate September 1981. . . . **Edmund F. Kelly,** Ph.D.'70, has been promoted to actuary in Aetna Life & Casualty's Group Division, Windsor, Conn. . . . **Terry Winograd,** Ph.D.'70, is presently associate professor of computer science and linguistics at Stanford University. . . . **Stephen L. Bloom,** Ph.D.'68, an author of numerous research publications and guest lecturer, is currently professor of pure and applied mathematics at Stevens Institute of Technology, Hoboken, N.J.

XIX
Meteorology

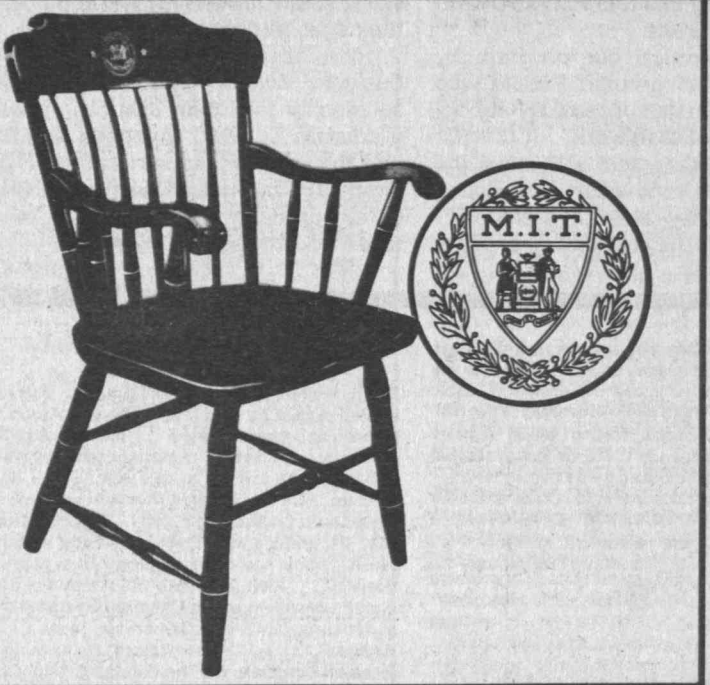
William Tahnk, S.M.'73, has been appointed Manager for Real-Time Data Acquisitions at ERT, Inc., Concord, Mass. . . . **Barbara A. Emery,** S.M.'75, reports, "Immediately after finishing my thesis at M.I.T., I went to France for 15 months as a postdoctoral exchange scientist at the Centre National D'Etudes des Telecommunications, outside of Paris. On my return to the U.S., I became a research scientist at the National Center for Atmospheric Research, where I do such things as auroral modeling." . . . **Abraham A. Perez,** S.M.'49, of Northridge, Calif., passed away on October 2, 1980.

Technology and Policy Program

Brian Mellea, '78, is working on a hazardous wastes project for Clark McGellon and Associates, a consulting firm in Boston. . . . **Rick Hornby,** '79, is presently working for the Nova Scotia Department of Mines and Energy as assistant to the deputy minister. Rick and his wife, Tracy, have a new son, Brian, born on March 18, 1981. . . . **Clint Stanovsky,** '81, and his wife, Elaine, are living in Renton, Wash. Elaine has been ordained as a Methodist minister. . . . **Rich Andrews,** '80, is now working as a staff consultant in the Chemical Specialties Unit at Arthur D. Little, Inc., Cambridge, Mass. . . . **Win Hayward,** '81, is in Washington, D.C., working as a research associate for The Futures Group. One of the projects he is involved in considers long-term policy options for transportation energy conservation.—Professor Richard de Neufville, chairman, Room 1-138, M.I.T., Cambridge, MA 02139.

M.I.T. INSIGNIA

A GOOD WAY TO REMEMBER



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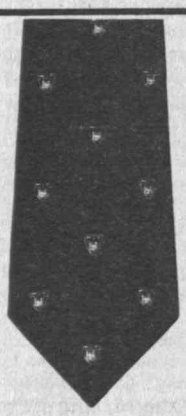

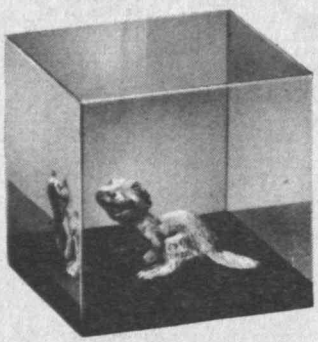

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Puzzle Corner
Allan J. Gottlieb

How Norbert Wiener Found His House

Allan J. Gottlieb, '67, is associate research professor of mathematical sciences at the Courant Institute of Mathematical Sciences, New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St., New York, N.Y. 10021.

My wife Alice and I are buying a house next week, so things are a little hectic as this is written. It's amazing how many details are involved. I naively thought that selecting the house and obtaining the money were the only time-consuming tasks. Wrong! There's painters, and insurance, and renting a truck, and moving, and . . .

Larry Bell would like recommendations for puzzle books to purchase other than those by Martin Gardner and James Fixx (which he already owns). If readers have particular favorites that you've read (or written!), please let me know.

A quick note: chess and bridge problems are in short supply.

Problems

A/S1. We begin with a chess problem from Roser Powell (and Sam Lloyd): Place the Black King in the center of the board and then place two White Rooks and one White Knight so that the Black King is mated.

A/S2. William Butler offers the following cryptarithmetic problem; he requires only that R = 1:

```
  R O O K
      T O
  K I N G
E I G H T
---------
C H E C K
```

A/S 3 Here's one from the M.I.T. Math Club:
It has been said that Norbert Weiner, the great (but absent-minded) mathematician, once lived in a housing development in which all the houses on his street were identical except for their addresses, which were consecutively numbered 1,2,3, . . ., m. In order to remember which house was his, Norbert discovered that his address, n, had the property that the sum of all the addresses less than n was equal to the sum of all the addresses greater than n. For what m and n is this possible?

A/S 4 Please help Irving Hopkins with his dog yard:
Compelled to fence in my dog, I have scrounged some pieces of picket fence from the dump. I have four pieces of lengths 3, 4, 5, and 6 units, and I want to arrange them so that the dog has a maximum area. What is the best configuration; and what is the maximum area?

A/S 5 Jack Parsons wants to know the probability that the World Series (if there is one) will be won by the team that wins the first game. (Two teams contest for the World Series, and the first to win four games is declared the victor; tie games are not possible.)

Speed Department

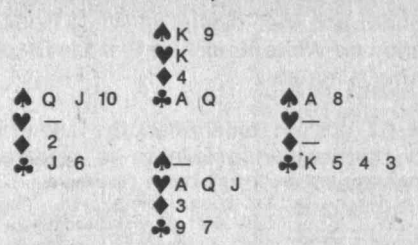
A/S SD 1 Here's a quickie adapted by Rex Ingraham from a problem posed by L. Boyd; the question is, What did the keeper say?
One time there was, or so it's told, a wise and wealthy Emir who prized his fine Arabian steeds and also his two sons. Before these sons to manhood grew he gave to each a fine Arabian foal

to prize and raise and call his own. When these fine foals had grown to steeds the wealthy Emir, dying, made known his will and named a goal two days distant from his bed; the brothers were to race their steeds, and to the one whose steed were first to reach the goal would go one third of all the Emir's wealth, while to the one whose steed were last would fairly go the rest of all the Emir's wealth. So then the brothers, vying, set out upon the race. But soon they slowed, and slowed and slowed until at nightfall they were nowhere near the goal but near an inn with stables where they then agreed they'd spend the night and also ask the keeper if they might fairly race while vying for the second place. The keeper understood their plight and said, "If you will agree to pay my fee for such advice, then I will say how you can do to do it." To this the boys agreed to pay the fee, and here is what the keeper said: "_____."

A/S SD 2 John Woolston needs a fourth flag pole of unknown length: At three corners of a field which measures 96 x 72 yards are flag poles. Those at diagonally opposite corners are 90 and 20 feet in height; the third pole is 60 feet high. It is desired to erect a fourth flag pole on the fourth corner, the *top* of which is the same distance from a point on the ground equidistant from the tops of the others as is that distance. (The solution to the question, "Why?", is left to the readers' fertile imaginations.)

Solutions

APR 1 South to lead and make all remaining six tricks with hearts as trump:



My old Baker House colleague, Peter Sorant, sent us a neat solution: South leads the ♥A followed by the ♥Q, on which dummy discards the ♣Q. Then South leads the ♦3 and ends in dummy with the following position:

East must hold the ♠A and ♠8; otherwise ♠9 will ruff out East's ♠A followed by a club to the ♣A and the good ♠K. West *must* hold the ♠Q and ♠J; otherwise the ♠K will ruff out East's ♠A *and* capture West's last spade, making the ♠9 in dummy good. This leaves *both* East and West with only one club each. North therefore cashes the ♣A and ruffs a spade in the South hand, then cashing the good club.

Mike Bercher sure has a sharp eye. In addition to discovering that the "I" was omitted from "Gottlieb" under my picture, he (as well as Smith Turner and Emmet Duffy) noticed that this problem first appeared in *Technology Review* two years ago. Also solved by Doug Van Patter, Richard Hess, Matthew Fountain, Steven Balbus, Gardner Bent, Ruth Lewort, Joseph Romm, Jerry Grossman, Charlie Maison, Richard Waters, Stuart Schulman, and the proposer, N. Piffenberger.

APR 2 In the game of Red Dog, a player is dealt four cards and bets that he can beat a fifth one by having a higher card in the same suit. Bets won or lost are taken from or added to the pot. What is the probability of winning (before looking at the four cards)? How many of the 48 outstanding cards should a player be able to beat in order to justify betting? (For simplification, assume a two-handed game in which each player, after looking at his/her cards, must either pass (without penalty) or bet the exact amount then in the pot.)

Most respondents believe that the second part is rather easy: if the odds of winning are at least 50 percent, bet. However, the proposer (Smith Turner) and I disagree. To quote Mr. Turner, "But PLAYER's loss is not picked up; it stays on the table, in the pot, and . . . there is a chance that his loss will increase the pot that he has a chance to pick-up on the next deal." For part one, however, there is agreement: for the four-card hand to win, it must

hold n ($0<n<5$) cards in the same suit as the fifth card. The probability of this event is

$C(12,n) * C(39,4-n)/C(51,4)$

in which we use C(r,s) to denote the number of combinations of r things taken s at a time. The probability that such a hand would win is

$n/(n+1)$.

Thus the probability of an unseen hand winning is:

$$1/C(51,4) \sum_{n=1}^{4} \{C(12,n) * C(39,4-n) * n/(n+1)\} = .37723 \ldots$$

Also solved by Harry Zaremba, Emmet Duffy, Michael Jung, Jerry Grossman, Richard Hess, and Matthew Fountain.

APR 3 Make a round-robin schedule for 12 teams which bowl on six double alleys, two teams to each double alley per night. Each team is to meet every other team once, with no team bowling either more than twice or twice in a row on any double alley.

Depending on how you interpret the problem, Harry Zaremba's solution is either correct or very close (but not both). Richard Hess scheduled the bowlers but was unable to meet the alley requirements. Mr. Zaremba's response follows:

It is presumed here that the "either/or" in the last two conditions means one or the other *but not both*. If the problem intends both conditions, then the solution below falls short by the narrowest of margins. The solution satisfies the following conditions:

☐ Each team bowls every other team only once. (Teams are identified by letters A to L.)

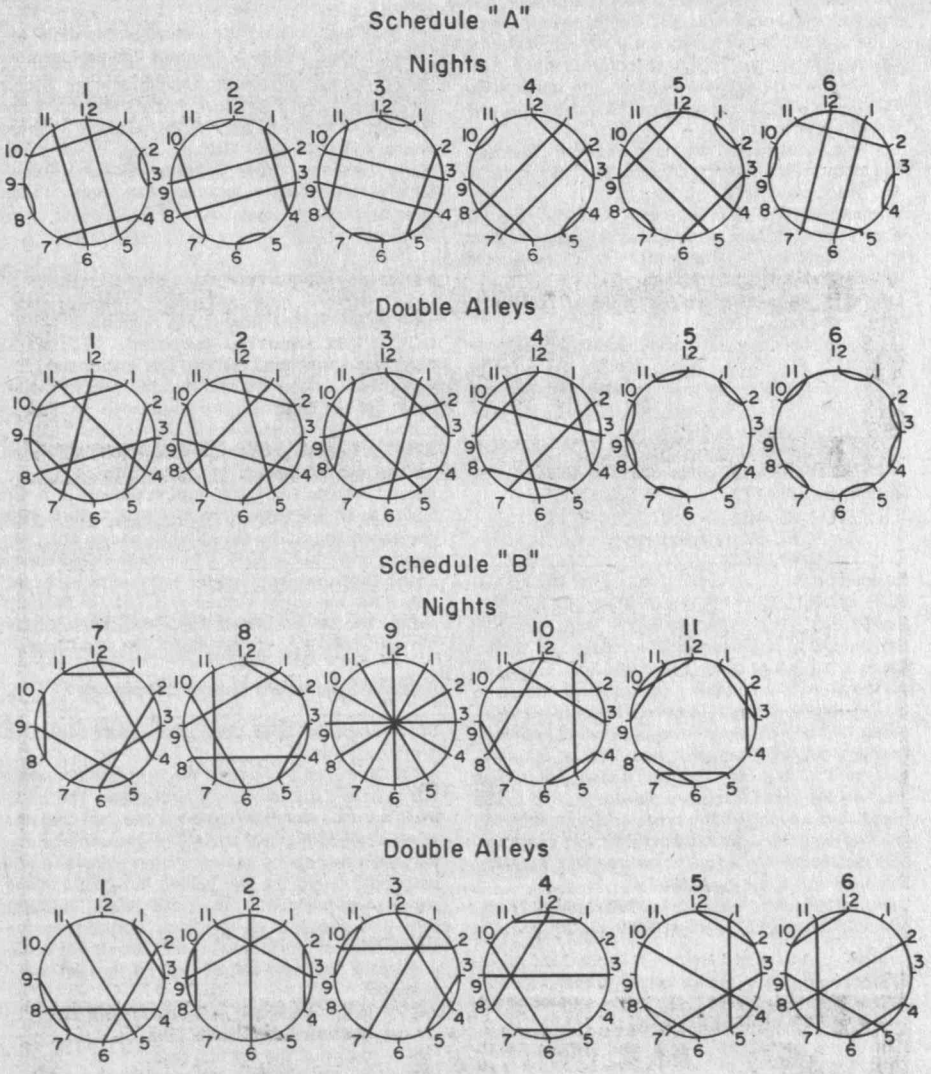
☐ No team bowls twice in a row on any double alley.

☐ All teams bowl at least once and no more than twice on each double alley except team I which bowls three times on double alley #1.

	1	2	3	4	5	6
1	AG	BL	CK	DJ	EI	FH
2	FI	AH	BG	CL	DK	EJ
3	EK	FJ	AI	BH	CG	DL
4	CH	DG	EL	FK	AJ	BI
5	BJ	CI	DH	EG	FL	AK
6	DI	BK	FG	AL	EH	CJ
7	HK	DF	JL	GI	AC	BE
8	BD	AE	IK	CF	GJ	HL
9	CE	IL	AD	HJ	BF	GK
10	IJ	GH	EF	AB	KL	CD
11	GL	JK	BC	DE	HI	AF

The proposer, Matthew Fountain, submitted the following solution (including the diagram, below) that meets all alley requirements:

My first plan of attack was to see if I could devise a schedule "A" for the first six nights of bowling during which all teams bowled once on each double alley. Next I would try to find a schedule "B" for the last five nights during which each team would bowl once more on five of the six double alleys. Permutations of the nights and alleys in schedules "A" and "B" would then permit meshing the schedules so as to avoid any team's bowling twice in succession on the same double alley. Proper notation was impor-



*Diagrams used by Matthew Fountain to construct the bowling schedule required by problem **APR 3**. Chords in night circles represent teams that meet at night; chords in double alley circles represent teams that meet on that double alley. For example, teams 1 and 10 meet on double alley 1 the first night, as the chord between 1 and 10 appears in the night 1 circle and the alley 1 circle.*

tant. Here it was most helpful to represent the teams by their position on a circle like the 12 numbers on a clock. Chords between teams represented meetings on double alleys. After much experimentation I hit upon the following solution which differs from my original conception only in permitting two teams in schedule "A" to bowl a second time on a double alley. The good mesh of schedules "A" and "B" appeared fortuitous, although it can be attributed to the large number of permutations available.

	1	2	3	4	5	6
1	1-10	5-12	4-7	6-11	8-9	2-3
2	3-8	7-10	2-9	1-4	11-12	5-6
3	2-5	4-9	8-11	3-10	6-7	1-12
4	6-9	1-8	3-12	2-7	4-5	10-11
5	4-11	3-6	5-10	9-12	1-2	7-8
6	7-12	2-11	1-6	5-8	9-10	3-4
7	2-6	8-10	4-12	1-11	3-7	5-9
8	4-8	1-9	3-5	6-10	2-12	7-11
9	5-11	6-12	1-7	3-9	4-10	2-8
10	7-9	3-11	2-10	8-12	1-5	4-6
11	1-3	2-4	9-11	5-7	6-8	10-12

Note that in this solution every team bowls at least twice (thrice, with no more than one exception per team) on other double alleys before returning to a double alley.

APR 4 Two well insulated compartments, filled with a "perfect" gas, are maintained at absolute temperatures T_1 and T_2, respectively. If a large tube connects the compartments, the pressures (P_1 and P_2) naturally tend to equalize. But (believe it or not) if the proportions of the tube are suitably reduced, the dynamical theory of gases indicates that a steady state will be reached in which the relationship $P_1/P_2 = (T_1/T_2)^{1/2}$ is approached. Can you verify and explain this formula?

This problem was well understood by Matthew Fountain in 1981 and by Osborn Reynolds in 1879! Mr. Fountain writes:

Connect the two chambers with a minute hole. At equilibrium the rate of molecules entering the hole from chamber (1) equals the rate of molecules entering the hole from chamber (2).

Let R_1 = rate of molecules entering hole from chamber (1)
C_1 = concentration of molecules in chamber (1)
S_1 = average speed of molecules in chamber (1)
P_1 = pressure in chamber (1)
T_1 = temperature in chamber (1)
k, K, and W = appropriate constants.

Then $C_1 = WP_1/T_1$

$P_1 = kC_1S_1^2$

$R_1 = KC_1S_1 = K(kC_1^2S_1^2/k)^{1/2} = K(P_1C_1/k)^{1/2} = K(WP_1^2/kT_1)^{1/2}$

At equilibrium

$R_2 = K(WP_2^2/kT_2)^{1/2} = R_1$ and $P_1/P_2 = (T_1/T_2)^{1/2}$.

Equilibrium will be reached much more quickly if the number of holes is greatly increased by substituting a porous plug for the single hole. Unglazed earthenware is a suitable plug material. According to Sir James Jeans, "Osborne Reynolds investigated this phenomenon in a series of experiments in which the two chambers were kept at temperatures of 8° C and 100° C. When a steady state was attained the pressures were measured, and it was found that, so long as the pressure was sufficiently low, the equation was satisfied with very considerable accuracy. At higher pressures this equation failed, as was to be expected."

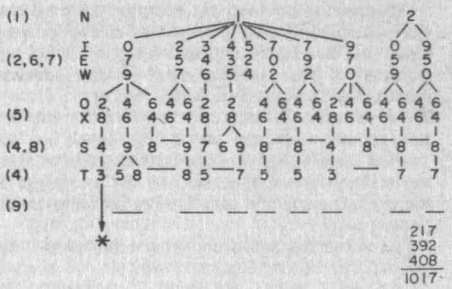
Osborne Reynolds' report is in *Philosophical Transactions*, Volume 170 (part II), 1879, p. 727.

APR 5 Substitute digits for letters to make the following addition correct, with some additional restrictions: "ONE" is divisible by 1, "TWO" by 2, "SIX" by 6, and "NINE" by 9; and "NINE" "SIX" "TWO" "ONE."

```
  O N E
  T W O
+ S I X
-------
N I N E
```

Cryptarithmetic puzzles are often popular and this one was no exception. Everyone used the given conditions to limit the possibilities and then either wrote a computer program or performed an exhaustive manual backtracking search (i.e., trial and error). I have chosen Avi Ornstein's solution since his carefully written diagram makes the (manual) procedure clear:

1. By adding three numbers, N must be 1 or 2.
2. NINE ÷ 9, so: if N=1, I+E = 7 or 16; if N=2, I+E = 5 or 14.
3. O & X are even; O+X = 10.
4. S>T>O.
5. Based on (3) & (4), O=2,4,6 and X=8,6,4, respectively.
6. O+X carries 1 to the next column, so W+I = 9.
7. Based on (5), if N=2, I,E,W ≠ 4 or 6.
8. SIX ÷ 6, so S+I+X ÷ 3.
9. O+T+S+I = NI.



Also solved by Ruth Lewart, Jerry Grossman, Emmet Duffy, W. Smith, Charlie Mason, Stuart Schulman, Dennis Sandow, Robert Mandle, Elliot Roberts, Chester Claff, Harry Hazard, Marlon Weiss, Mike Bercher, Michael Jung, H. Maynard, Harry Zaremba, Steve Feldman, Howard Eglowstein, Frank Schafer, Norman Wickstrand, Frank Carbin, Richard Hess, and the proposer, Abe Schwartz.

Better Late Than Never

1980 M/A 4 Sidney Shapiro has responded
OCT 2 David Lukeus has responded.
1981 JAN 1 Raymond Gaillard has responded.
JAN 4 Rick Decker noticed that this problem is an easy consequence of the invariance of "cross ratios" under "projective transformations."
APR SD 1 Addison Ellis and Stuart Schulman have noticed a musical error. Mr. Ellis writes:
When "Tea for Two" is written in the key of A flat major as in what you call "the strip," the words corresponding to the seven notes shown are, "Me for you and you for me." These notes would correspond to the words, "Tea for two and two for tea" only if the tune were written in the key of G sharp major. And Mr. Schulman adds that another possible correction is to change the G clef to a C clef.

Proposers' Solutions to Speed Problems

SD 1 Tomorrow, boys, each of you must mount his brother's horse.
SD 2 Of course the size of the field is immaterial, but excess data sometimes add spice. The intuitively obvious solution relies on the fact that the locus of all points in a plane (the ground) equidistant from two points outside of the plane is a line perpendicular to the line joining the points in the plane perpendicularly below the points in question—i.e., the side of the field. Considering the intersection of this locus line with the side in question—(use that between 90 and 60 foot poles for example).

If S = length of side
a = distance from the 60′ pole
h = height of the 4th flag pole

$(90)^2 + (s-a)^2 = (60)^2 + a^2$

$h^2 + (s-a)^2 = (20)^2 + a^2$ SO

$(90)^2 - (60)^2 = a^2 - (s-a)^2 = h^2 - 20^2$, or

$h^2 = (90)^2 - (60)^2 + (20)^2$; therefore

$h^2 = (70)^2$ or h = 70

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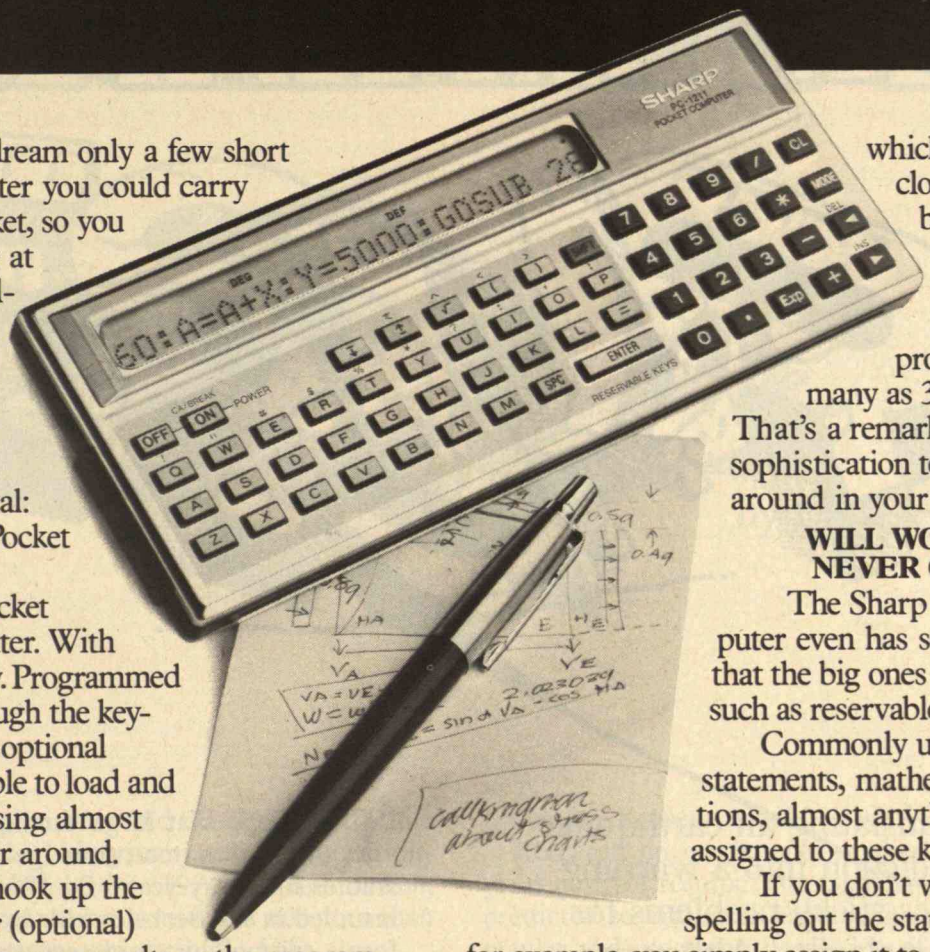

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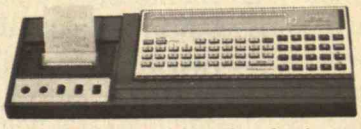

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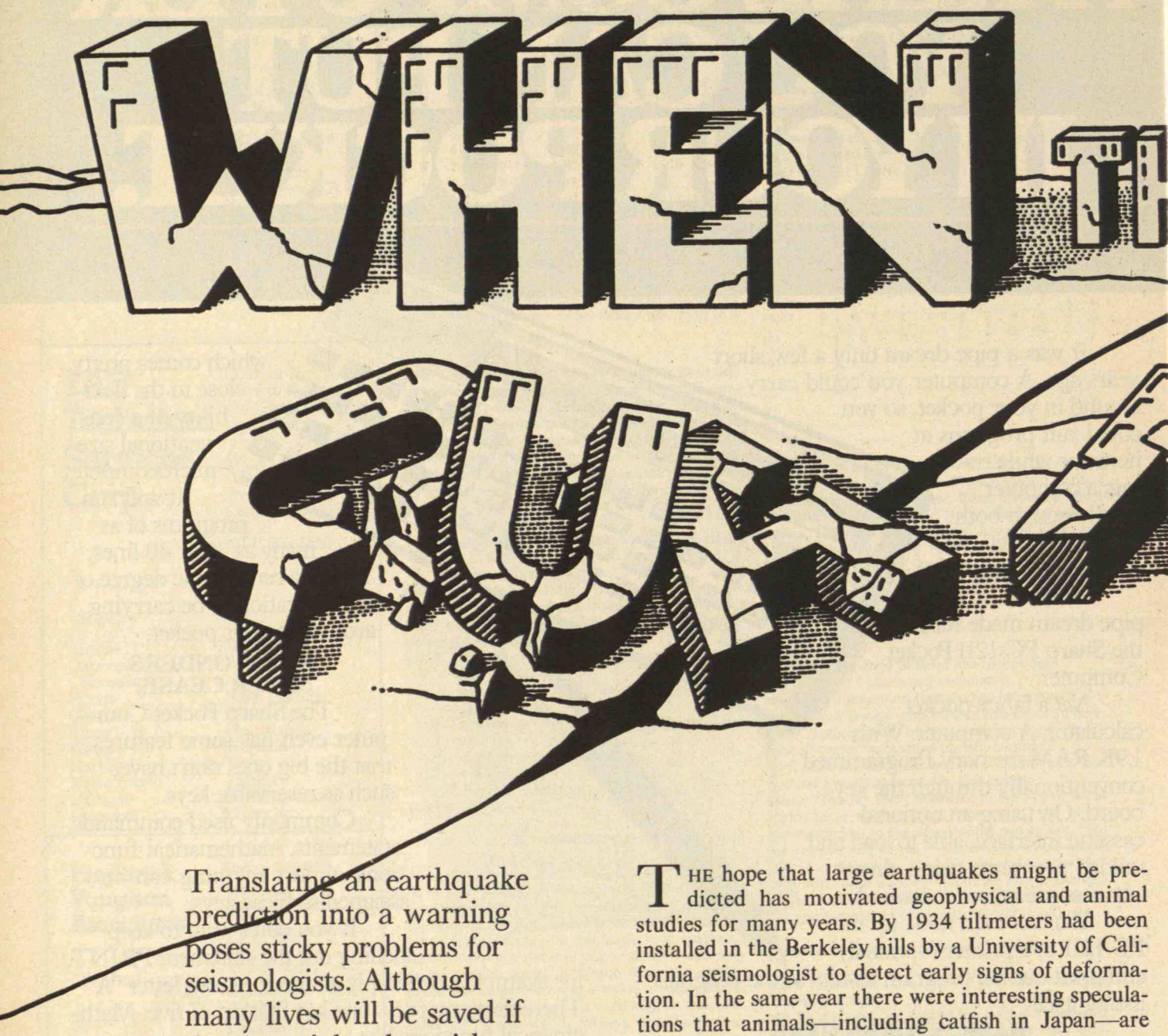
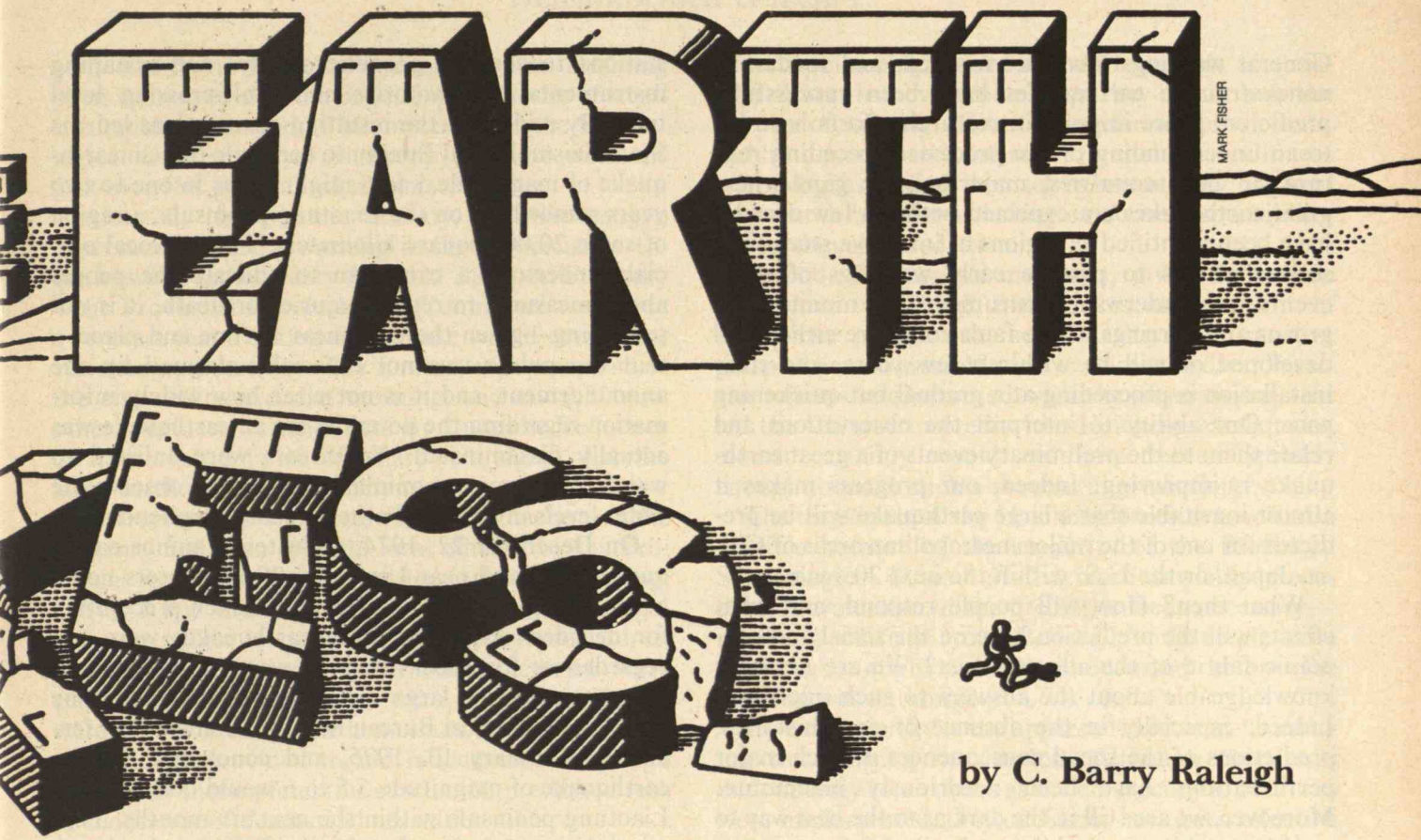


Translating an earthquake prediction into a warning poses sticky problems for seismologists. Although many lives will be saved if they are right, they risk public humiliation and liability if they are wrong.

THE hope that large earthquakes might be predicted has motivated geophysical and animal studies for many years. By 1934 tiltmeters had been installed in the Berkeley hills by a University of California seismologist to detect early signs of deformation. In the same year there were interesting speculations that animals—including catfish in Japan—are somehow able to sense impending major tremors.

However, only since the 1960s have earth scientists mounted a serious effort to determine whether prediction is feasible in a socially useful sense. Devastating earthquakes in the 1960s in China, the USSR, and the United States touched off research programs in all three countries aimed both at predicting and mitigating the effects of earthquakes. The Japanese program now has funding four times that for comparable research in the United States. In China, the commitment of labor to research on earthquake pre-



by C. Barry Raleigh

diction is awesome; we were told that 10,000 full-time workers—perhaps including many attached to peripheral efforts—were involved in 1974. By comparison, the most liberal accounting would find no more than 500 full- and part-time workers in the U.S.

The principal justification for such efforts in Japan and China is that a timely prediction of a major earthquake could save many lives: over half a million people have died in these two countries in three earthquakes in this century. Most of the major cities in China and Japan, including Beijing and Tokyo, are at serious risk from great earthquakes, the political and social consequences of which would be severe, even calamitous. In China, effective prediction is currently the only plausible method of averting what must be the greatest risk from earthquakes to the populace of any nation on earth. The alternative—replacement of the unsafe masonry structures in which most Chinese people are housed—would be vastly expensive.

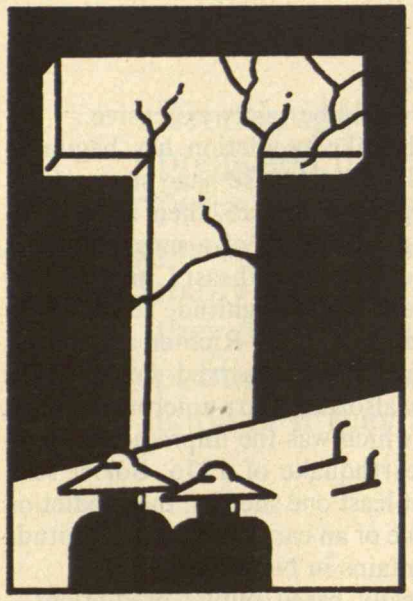
Research on earthquake prediction has begun to yield positive results. The Chinese have successfully predicted several large earthquakes, their most spectacular success being prediction of a magnitude-7.3 earthquake near Haicheng in northeast China in February 1975. (This measure of magnitude refers to the amount of energy release on the Richter scale, with the highest magnitude ever observed being about 8.9.) But the Chinese also admit to numerous failures, the most notable of which was the unpredicted, catastrophic Tangshan earthquake of 1976. Soviet seismologists have had at least one success: the prediction a few hours in advance of an earthquake of magnitude 7 in the Pamir Mountains in November 1978.

No such scientifically based public predictions—specific as to the place, time, and magnitude—have officially been made in Japan and the United States.

General warnings have been issued, and moderate, nondestructive earthquakes have been successfully predicted. More important, research efforts have led to an understanding of the processes preceding rupture. In both countries, major seismic gaps where great earthquakes are expected within a few decades have been identified as regions of intensive study, and serious efforts to provide early warnings of those events are underway. Instruments to monitor the groans and stirrings of the fault zones are either well developed or will be within a few years, and their installation is proceeding at a gradual but quickening pace. Our ability to interpret the observations and relate them to the preliminary events of a great earthquake is improving. Indeed, our progress makes it almost inevitable that a large earthquake will be predicted for one of the major metropolitan areas of China, Japan, or the U.S. within the next 20 years.

What then? How will people respond, and what effects will the prediction have on the social and economic fabric of the affected area? We are not very knowledgeable about the answers to such questions. Indeed, especially in the absence of case histories, predictions of the social consequences of such major perturbations have been notoriously inaccurate. Moreover, we are still in the dark as to the best way to arrive at and issue a public prediction.

The Prediction of the Haicheng Earthquake



THE Liaoning Province had been targeted by 1970 as one of the principal areas of high seismic risk in China. A phase of intensive seismic activity had begun in Northeastern China, the result of a migration of large earthquakes from Hopeh Province in the southwest toward the northeast over a period of three years prior to 1969. Noting this pattern, the Chinese began a program of intensified seismic observations in Liaoning Province, adding 17 stations to conduct geodetic surveys and installing instrumental observatories and fault-crossing level lines. By mid-1974 the resulting observations led the State Seismological Bureau to conclude that an earthquake of magnitude 5 to 6 might occur in one to two years somewhere on the Liaotung peninsula, a region of some 20,000 square kilometers. Though local officials undertook a campaign to educate the people about measures to reduce injuries or death, it is not surprising—given the vagueness of time and place—that the public was not especially alarmed by the announcement, and it is not clear how widely information regarding the potential for an earthquake was actually disseminated. Volunteers were enlisted to watch for anomalous animal behavior and observe the water levels in wells and other precursory phenomena.

On December 22, 1974, a cluster of minor earthquakes occurred near Liaoyang, 70 kilometers north of Haicheng, an area that had not shaken preceptibly for decades. Although these earthquakes were not regarded as foreshocks and no warning was issued, preparations for a large earthquake accelerated. The State Seismological Bureau held a nationwide conference on January 13, 1975, and concluded that an earthquake of magnitude 5.5 to 6 would occur on the Liaotung peninsula within the next six months. That conclusion was relayed to local officials and seismological workers on January 28 at a meeting convened by provincial authorities.

Thereafter seismologists began daily meetings to review updated observations, and the Liaoning Provincial Revolutionary Committee called an emergency meeting and proceeded to see that every family received information on earthquake hazards. There also seems to have been a sharp increase in the activity of amateur observers. Whether this was stimulated by official urging or by nature isn't known, but public awareness of the potential for an earthquake evidently increased substantially.

There seemed to be ample justification for public warning. The ground at two observatories showed unusual tilting for that time of year, one case being especially obvious. There were several incidents of large changes of electric potential between buried electrodes before the end of January and many reports of changes in the level and turbidity of well water. Reports of anomalous animal behavior came with increasing frequency after the Liaoyang earthquake swarm in late December.

These effects, in association with a number of small but perceptible earthquakes, caused considerable con-

The apparent responsiveness of the Chinese public when exhorted to leave their homes in subfreezing temperatures suggests an unusually well-informed citizenry.

cern. Finally on February 1 came the most alarming phenomenon of all—the beginning of a series of small earthquakes centered 20 kilometers from the Seismological Observatory at Shihpengyu. These were the first ever felt by local inhabitants.

After all this seismic activity, the Shihpengyu observatory issued a warning to the provincial earthquake office on February 3, and at 3 A.M. on February 4 the Provincial Revolutionary Committee was given a forecast that a strong earthquake would occur near Haicheng on that day. The forecast was passed on to the city committee that morning, and at 10:30 A.M. other provinces were notified. By 2 P.M. the frequency of tremors had fallen off sharply, a signal that the large earthquake was imminent.

Instructions on measures for the protection of the citizenry had been given to local officials by the Provincial Revolutionary Committee early that morning, and at 2 P.M. these officials were instructed to organize the public to carry out emergency procedures. Emergency shelters and first-aid facilities were staffed and medical teams were organized. People were urged to leave their homes and remain outdoors, with movies provided to add inducement. Although apparently incomplete, this evacuation prevented tens of thousands of deaths and casualties.

The earthquake actually came at 7:36 on the evening of February 4.

Lessons from Haicheng

most remarkable aspect of these events is the accuracy of the earthquake prediction. Several factors made this possible. First, the Chinese have learned from experiences such as the earthquake at Tangshan in 1976 that failure to warn people may result in terrible death tolls. Therefore, both officials and the general public are likely to be tolerant of predictions that turn out to be incorrect. Indeed, seismologists are blamed for errors of omission rather than overzealousness; they do not bear the burden of adverse effects of erroneous predictions. Public demand and interest are such that Chinese seismologists regard themselves as not only engaged in research but also as having an active responsibility for earthquake prediction.

Second, Chinese seismologists, given their wide experience with large earthquakes and patterns of anomalous phenomena, seem to have an intuitive grasp of how to assemble and evaluate the data. Western scientists, confronted with the observations that led the Chinese to predict the Haicheng earthquake, almost certainly would not have reacted quickly enough to make such a successful prediction.

The timeliness of the Haicheng prediction was also possible because of the authority of the Provincial Seismological Bureau. Had a more unwieldy procedure of evaluation of the prediction been necessary—involving officials from Beijing, for example—the earthquake might well have occurred before the warning was authorized.

Also noteworthy is the apparent success at translating the warning into action. Although there was undoubtedly some chaos as the emergency procedures were implemented, they could not have been effective unless a substantial degree of preparedness had been achieved in the course of the earlier intermediate and short-term predictions. The apparent responsiveness of the general public when exhorted to leave their homes in subfreezing temperatures also suggests an unusually well-informed citizenry. The Chinese have widely distributed booklets, movies, and charts containing basic information on earthquakes and measures to reduce loss of life and damage to property. Prediction is treated factually, with the result that people are predisposed to understand and respond positively to advance warnings. Trained volunteers provide an effective channel for authoritative information to the public.

Could It Happen Here?

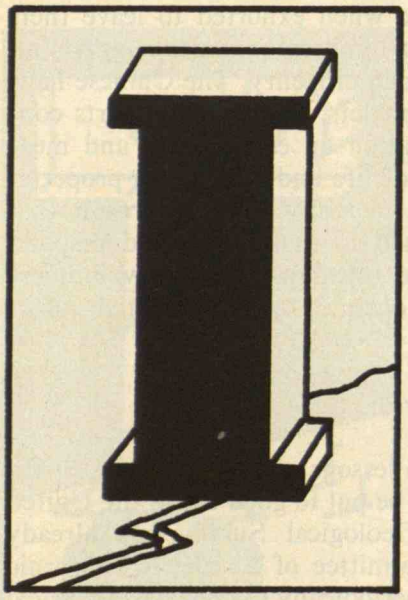
At least some of the lessons of the Haicheng earthquake prediction can be put to good use in the United States. The U.S. Geological Survey has already formed a review committee of Southern California scientists who meet periodically to review geophysical observations. Their role is similar to that of the Liaoning Provincial Seismology Office—to keep informed on geophysical changes so that they are prepared to

recognize truly anomalous patterns. The survey's difficulties in assembling data from several different sources and presenting it intelligibly to the committee are gradually being overcome.

The involvement of volunteers who measure water levels, keep track of unusual animal behavior, and call a hot-line number when necessary has also increased since 1978. These volunteers are served by a newsletter on interesting earthquake developments and volunteer activities and observations. But because these volunteers number less than 1,000, their contribution to earthquake preparedness is still small.

Differences between Chinese and American science and politics also affect earthquake prediction. U.S. scientists are not likely to be afforded the margin for error given to their Chinese counterparts. U.S. scientists bold enough to publicly predict an earthquake that does not occur risk their reputation and may become the object of ridicule by the media, or even of litigation by individuals who claim hardship from preparation for the earthquake. Indeed, scientists who have publicly forecast earthquakes have been treated more to contumely than applause. Seismologists have thus become understandably reluctant to make more than the most general public statements about the probability of a large earthquake.

To Know or Not to Know?



INDEED, translation of scientific information not fully digested and published presents a difficult dilemma for scientists. In many respects, our understanding of earthquakes and the phenomena that may make possible their prediction is still very incomplete. Yet public safety clearly conflicts with our proper reluctance to discuss poorly understood observations. When are we to conclude that our data have significant portent, and how poor a case are we to be held accountable for? For example, if I judge that simultaneous increases in the emanation of radon gas from wells and large and unusual changes in the pattern of strain accumulation portend increased and possibly damaging seismicity, am I bound to let the public know even though uncertainty is large?

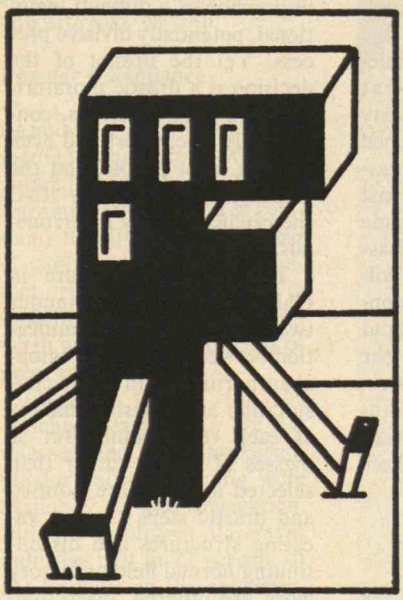
This example is not hypothetical. A radon anomaly, confined to a few wells, was found in the Transverse Ranges in Southern California in 1979; other observational wells showed no change. The pattern of strain accumulation had begun to change in such a way as to reduce the frictional stresses blocking motion on the San Andreas fault, while shear stresses tending to make the fault slip continued to increase. No other observations suggested cause for alarm. Some scientists were sufficiently concerned to urge a public warning; others doubted that any conclusive judgments could be made. After carefully reviewing all the data, we concluded that the prior associations of anomalous radon emanations with earthquakes pointed toward the occurrence of a moderate, magnitude-5 earthquake near Los Angeles, but we emphasized that there was insufficient cause for alarm as no other strong indications had appeared. Within two weeks an earthquake of magnitude 6.8 struck El Centro in the Imperial Valley, but no magnitude-5 event occurred near Los Angeles.

Even before the meeting at which we forecast the magnitude-5 earthquake near Los Angeles, George Alexander, the enterprising science editor of the *Los Angeles Times*, picked up the story of the increased radon emanation. After discussing it with several geophysicists, he wrote an accurate description of the observations and their possible significance. Mr. Alexander was careful to include all the qualifiers so often inadequately represented in media accounts. Later, immediately after the review meeting, we revealed our observations and conclusions at a widely reported press conference. As a result, the public was generally well informed about our analysis and conclusions, and there was no panic and no derision when our forecast turned out to be wrong. We learned an important lesson from this and similar events: with a subject so intensely interesting to the public, seismologists must become accustomed to working in a fishbowl and indeed can find the press a responsible ally. The hope that we can withhold significant observations concerning a future earthquake is simply unrealistic. Such information will always be discovered, and if it reaches the press unintentionally, scientists' reservations are likely to be lost.

We are still convinced
that the business of science is properly conducted in journals,
but on some occasions the public's need to know
must be served first.

We are still convinced that the business of science is properly conducted in journals where the critical judgments of peers can be brought to bear before those of the general public. But on some occasions the public's need to know must be served before this procedure is completed. In these cases, scientists must give the same care to public statements as to technical articles. Misunderstanding by the press is commonly caused by imprecision in scientists' public statements.

The Effects of Action and Inaction



FOR the future, as scientific understanding of earthquakes and their precursor events matures, there will undoubtedly be occasions when public prediction of earthquakes is morally compelling. Each prediction, almost surely formulated by a committee of geophysicists such as the one in Southern California, rather than an individual, will be reviewed by a standing committee of federal and academic scientists that advises the director of the U.S. Geological Survey. The director, in turn, will notify the governors of the affected states, and these and other local officials will take whatever actions they deem appropriate. If the prediction is for California, the chief of the state's Division of Mines and Geology will convene the Governor's Council on Earthquake Prediction.

The proper official response to such predictions is now under study in California. Already the city of Los Angeles has before it the consensus report of a task force on the question. This thoughtful document contains many recommendations, some of which should be adopted whether or not there is an earthquake prediction. Examples include reinforcing commercial structures having masonry bearing walls, strengthening highway bridges, and anchoring power station equipment. New ordinances are gradually being passed to remedy the most hazardous deficiencies.

But some issues remain completely unresolved. For example, does the city of Los Angeles have legal authority to invoke emergency measures in response to a prediction of an earthquake? Are the governor and/or city officials liable for the effects of inaction if an earthquake occurs following a scientifically plausible prediction? If city officials invoke emergency procedures despite a governor's inaction, are they liable for damages incurred should the earthquake not take place? If a long-range prediction is made with some appropriately low estimate of the annual probability, say 10 percent, is a city liable if it fails to take remedial action?

Maps of the probable patterns of damage from a predicted earthquake would help public officials determine how to safeguard lives and property, but such maps may also generate changes in property values, and liability may be incurred. On the other hand, if the maps are not utilized, injured individuals in a zone where high earthquake intensities were predicted could claim liability. And once such a map exists, are the cities affected not then compelled to plan for disaster?

Some of these legal issues are now under legislative study in California. The simplest—the question of the potential liability of scientists whose predictions turn out to be erroneous—now appears to be resolved: there is no liability provided that scientists have been conscientious in their treatment of data and release of information. Resolution of the more complex liability issues must await the outcome of future court tests.

The potential impact of an earthquake prediction on a local economy has been studied at the University of Colorado's Institute of Behavioral Science by J.E. Haas and D.S. Mileti, who asked a sample of business executives, families, and public officials how they would respond to a series of earthquake forecasts. The series began with a public notification by the director of the U.S. Geological Survey of the potential for a large earthquake in a specific area—a "hazard watch" (explicitly not a prediction) issued by two or more reputable, nonfederal seismologists, who estimated a 25 percent probability that a damaging earthquake would occur within three years. Though this hazard watch triggered anxieties in those queried, Haas and Mileti found no specific responses. One year later, according to the scenario, the USGS revised its hazard watch into an official prediction of a magnitude-7

Continued on page 54

The Chinese People and the Haicheng Earthquake

THE following are excerpts from the report of the U.S. Haicheng Earthquake Study Delegation that traveled to China in the summer of 1976 under the auspices of the U.S. Committee on Scholarly Communications with the People's Republic of China. Members of the delegation were Barry Raleigh, Gordon Bennett, Harmon Craig, Thomas Hanks, Peter Molnar, Amos Nur, James Savage, Christopher Scholz, Ralph Turner, and Francis Wu. The full report appears in *EOS*, the Transactions of the American Geophysical Union, May 1977, from which these excerpts are reprinted by permission.

A leading sociologist observed that the Chinese like to let their theories grow slowly, like plants responding to the environment, without the kind of rigorous academic analysis that Westerners are used to. This statement describes the earthquake program reasonably well, with its emphasis on massive empiricism and correlation. Like opera singers who daily swallow 15 cold preparations to ward off a disabling sore throat without knowing which combination is effective, China's earthquake workers are concerned only with results. They explore virtually every potentially useful avenue of experience and tradition.

The actual Chinese earthquake program contains several clear and overt messages. The first is concern. We were told that officials in the old days cared little about people's suffering from natural disasters, and some even found ways to profit; today all that has changed. Immediately after the main shock at Haicheng on February 4, 1976, the Party Central Committee telegraphed a message of sympathy to the people of the stricken area and dispatched a delegation to the disaster site. Leading cadres of the Liaoning Provincial Party Committee and municipal party committees in the quake area headed delegations to oversee relief activities. Large quantities of flour and pork were rushed to the scene to make possible the upcoming traditional celebration of Spring Festival, and members of the central delegation celebrated the festival with communities that had suffered exceptional damage.

The second message is that China has the capacity to predict destructive quakes and take preventive measures. A perfect track record is unnecessary, though a good one is important. The idea is that the authorities are not merely reacting to the ravages of nature, like a raft rising and falling at sea, but rather that they can take the initiative. Such measures breed confidence.

The third message is that the government is prepared to distribute needed relief services and supplies. First are crucial items such as food, water, medical teams, and materials to repair power generators, railway bridges, and so on. Each bottle of water brought by the People's Liberation Army (PLA) to Yingkou, where water mains broke, was labeled with red paper as "love-the-people water"—to educate the younger generation, we were told. Many medical teams were identified as being from neighboring cities and provinces, and 29 province-level units were said to have contributed relief commodities at Haicheng.

The fourth message is that it is possible, with help from the government's many-faceted program, to overcome the effects of an earthquake quickly and resume normal production. At every stop our hosts in Liaoning emphasized that they had managed to reap a harvest in 1975 that surpassed previous records. Some also said that they had achieved "one hog per brigade member," a goal throughout China. By the end of March that year, 96 percent of the factories in Yingkou municipality had resumed normal production.

The fifth message is the contrast between post-Liberation (from 1949 on) and pre-Liberation periods in China, which helps explain the often effusive praise given the present government. When the central party's sympathy telegram was received at Shuiyuan brigade, the party branch immediately convened a "meeting to compare present sweetness with the past bitterness" with older brigade members, recalling a disastrous 1942 flood in their village. The party members concluded that "thinking about the past and looking at the present, we poor and lower-middle peasants see that without Chairman Mao and socialism we would not be here today!"

The Wisdom of the People

As in medicine, a virtue of the Chinese approach to earthquake prediction is an open mind toward traditional folk wisdom. We are in no position to evaluate claims that the people have predicted earthquakes for centuries. But the emphasis on animal behavior, anomalies in well water, meteorological changes, and earth lights and sounds is based on folk tradition and written accounts. This approach contrasts with the American experience in which anomalies in animal behavior preceding earthquakes have often been reported popularly but are generally dismissed without serious investigation by seismologists. However, Chinese earthquake scientists have carefully sifted through and rejected some aspects of folk tradition and retained others, and educational programs impress this distinction on the people.

A major focus of concern in the United States is how the weighty decision to issue a public warning and coordinate community response will be made in case of an earthquake prediction. The bland, matter-of-fact accounts of Chinese decision making convey no impression of a difficult, emotional, potentially divisive process. Yet the upshot of the decision is a drastic moratorium on normal activities, considerable discomfort and even risk for most people, and the inescapable possibility that the prediction may be erroneous.

The normal procedure in China consists of a continuous two-way flow of communication between local and regional authorities, with group consultation and decision making at each relay point. But as masses of people rather than selected agencies are notified and drastic steps such as vacating structures and discontinuing normal field or factory work are ordered, discretionary authority seems to be local. This pattern may facilitate decision making. Higher-level units are relieved of some of the onus of disrupting people's lives, and the local authority is better able to convince doubters and more likely to be viewed with understanding in case of a false alarm.

Another notable feature of decision making in China is the conferences that bring together various groups and perspectives. When one amateur group reports what seem to be significant anomalies, the seismic station calls a conference with other amateur groups in the area. If the conferees decide that the information is

important, it is referred to the city or county seismological office, which may then call another conference.

A similar sequence of conferences beginning on the national level and moving to province and county levels marks the trend toward evermore-pinpointed prediction. Even at the commune and brigade levels, decisions are made by leading members rather than single executives. Although Americans might view such conferences as obstacles to decisive action, the opposite may be true.

Popular Compliance

Because of the much-documented reluctance of Western populations to take disaster warning seriously and a common, usually unjustified fear of panic and community conflict, the Chinese success in securing popular cooperation when warnings are issued is of great interest.

Casualty figures for the Haicheng earthquake are not released and only spokespeople for successful units were available to the delegation. But one published statement indicates that in 72 percent of the brigades in the epicenter, not one person was killed despite widespread damage. Although this gives us no clue as to the magnitude or cause of casualties in the remaining 28 percent, the fact that full cooperation could have been attained in so many units is impressive.

Several factors made the warning effective:

☐ The collective effort to ensure the survival and well-being of the many rather than the few is a feature of modern Chinese society.

☐ The almost complete absence of earthquake-resistant construction in much of the area at risk may have fostered communitywide cooperation. Because very few people could feel secure in their homes or workplaces, the threat was harder to discount.

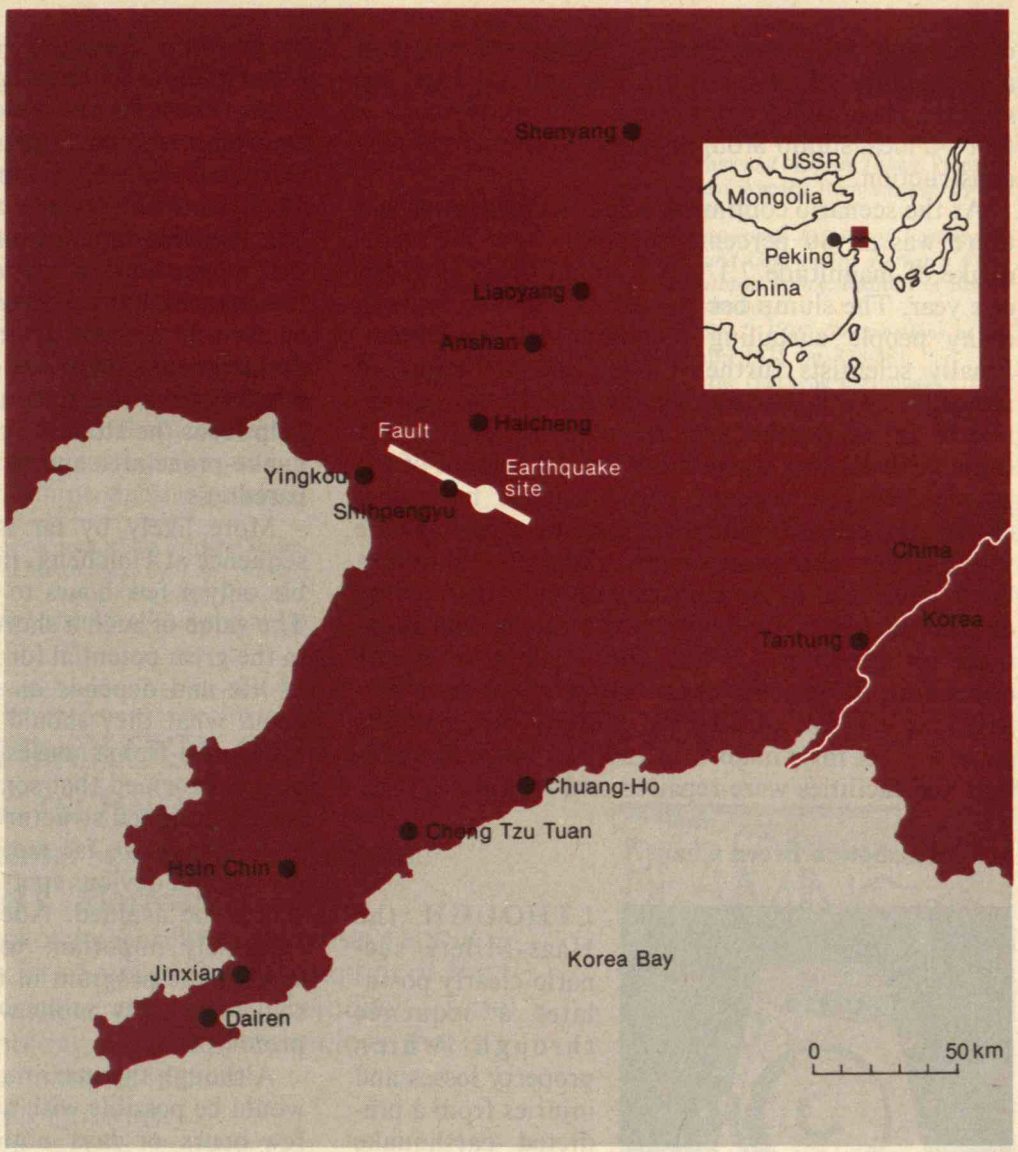
☐ The nature of the events may also have worked in favor of Chinese efforts. Two kinds of warning signs were experienced: perceptible foreshocks during the two days before the main quake, and escalating reports of anomalies in animal behavior, well water, and other natural phenomena. These signs that people could see for themselves or hear about from their neighbors enhanced the credibility of official predictions.

The Chinese earthquake program was wisely conceived in several ways:

☐ Earthquake prediction was established as a national policy of the highest priority, not a minor experiment viewed with a skeptical eye.

☐ The people themselves were significant contributors to the prediction effort and were instructed on reinforcing their homes against earthquake damage. Involvement in such supportive action enhanced their commitment.

☐ Popular compliance was sought through comprehensive use of authority, support, and persuasion. Persuasive efforts were concentrated on the disbelievers; in some locations the latter were bodily removed from their homes. But we do have reports that individuals who resisted all blandishments eventually became casualties. There is no utopia, even in China. ☐

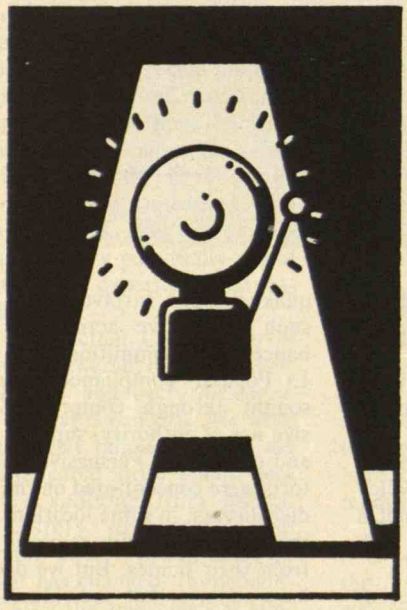


We in the geosciences still worry that our first effective earthquake prediction may have more chaotic than productive results.

earthquake within two years in a designated area with a probability of 50 percent. The interviewees' responses then indicated a significant economic effect—a local slump brought on by curtailment of new construction.

As the scenario continued, scientists estimated that there was an 80 percent probability that an earthquake of magnitude 7.1 to 7.4 would occur in about one year. The slump became a local depression, with many people curtailing spending and investment. Finally scientists further refined the prediction to indicate that a severe earthquake would occur within two to three months, and the economy of the area came virtually to a standstill. Some 60 percent of the people left (10 percent permanently), businesses closed, and property values declined by a third. There was but one exception to this gloomy condition: a boom developed in the construction industry because of owners' desires to improve the earthquake resistance of buildings. When the earthquake finally occurred, injuries and loss of life were nearly eliminated as a result of advance preparations, and the stage was set for a major construction boom as buildings and facilities were repaired and rebuilt.

Must Prediction Breed Chaos?



ALTHOUGH the Haas-Mileti scenario clearly postulates a sequence through which property losses and injuries from a predicted earthquake are minimized, it also shows that the short-term economic impact of a widely disseminated earthquake prediction would be severe.

However, realization of the orderly Haas-Mileti scenario is quite unlikely. No reputable scientists think that it is possible to make long- or intermediate-term predictions of great earthquakes with probabilities greater than a few percent per year. For example, the San Andreas fault in Southern California appears to generate damaging earthquakes near Palmdale about every 140 years, give or take about 80 years. Thus, except for the few decades after an earthquake, the best prediction is an annual probability of a severe earthquake of about 1 percent. In a period such as 1979, when the pattern of strain accumulation in the San Andreas took an ominous turn, the probability that an earthquake would occur might be raised to a few percent, but we do not expect that it can reach 80 or even 55 percent. Even allowing for new technical developments, we do not expect long-term earthquake predictions to be accurate enough to do more than help focus the attention of geophysicists on the earthquake-prone area and to raise the level of public preparedness.

More likely by far is a scenario replicating the sequence at Haicheng, in which a prediction is possible only a few hours to a few days before an event. The value of such a short-term prediction lies mainly in the great potential for reduction of injuries and loss of life and depends on people being well informed about what they should do to avoid injury. California's wood-frame houses are good refuges in an earthquake, provided that some precautions are taken and poorly designed structures are avoided. Certain kinds of buildings are far more susceptible to failure than others, and obvious spots such as downtown sidewalks should be avoided. Adequate public information is extremely important to insure an appropriate response; the program in Long Beach in which unsafe structures carry public warning labels is an important prototype.

Although the maximum reduction of property loss would be possible with a long-term prediction, even a few hours' or days' notice of a tremor could reduce losses significantly. Firefighting equipment could be readied and removed from the hazardous structures in which it is typically housed, and water levels in dams could be lowered and nuclear reactors shut down.

The National Security Council and the Federal Emergency Management Agency have estimated that a single earthquake in California could cause 20,000 deaths and 90,000 injuries requiring hospitalization in the worst case, with an uncertainty factor of 2 to 3. Property losses in the tens of billions of dollars—with the same uncertainty factor—would accompany any such earthquake. Clearly, the effort to make more effective predictions has significant potential for human and economic benefit.

The same effort would also offer a chance to resolve an intriguing and fundamental problem—the manner

in which great earthquakes originate. Although respectable progress has been made in this area in the past several years, a useful model of earthquake activity from which predictions could be generated may still be decades away. The most serious need is for an adequate base of observations. The earth's surface is a noisy place in which to make measurements, and efforts to obtain better sound resolution are costly.

But improved understanding leading to more accurate prediction will not assure that lives are saved and damage reduced. Our cities and states also need better mechanisms for ensuring that a warning engenders an appropriate response. We in the geosciences still worry that our first effective earthquake prediction may have more chaotic than productive results.

C. Barry Raleigh is program coordinator for research on earthquake prediction at the U.S. Geological Survey in Menlo Park, Calif.; he will join Columbia University's Lamont-Doherty Geological Observatory this fall. Dr. Raleigh received his Ph.D. from the University of California at Los Angeles in geology in 1963.

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Reindustrialization: Aiming for the Right Targets

by Nathaniel J. Mass and Peter M. Senge

AMERICA'S competitive position in world manufacturing has weakened dramatically since 1960. The nation's share of manufacturing exports has fallen from 25 to 17 percent, while sales of foreign manufactured goods in the United States have more than tripled. *Business Week* estimates that the declining competitiveness of American industry cost the nation 2 million jobs and $125 billion in sales during the 1970s alone. Other symptoms of decline include the diminished fraction of gross national product (GNP) represented by private investment, a long-term decline in technological innovation, and falling expenditures on research and development.

What is at the root of these disturbing trends, and how can they be reversed? *Reindustrialization*, we are told, is the answer—a massive investment of capital in major technological improvements that will boost productivity, increase industrial efficiency at home, and reestablish U.S. competitiveness in foreign markets.

Certainly the basic goals of reindustrialization are laudable. But to be successful, economic policies must address the fundamental causes of America's industrial stagnation. Using the System Dynamics National Model at M.I.T., we have attained a new understanding of the forces behind that stagnation—and of policies to overcome it.

A Model for Understanding Economic Change

The National Model is structured around three major sectors of the U.S. economy: capital, consumer goods, and household. It connects these sectors with flows of people, money, prices, goods, and information, attempting to explain macroeconomic behavior by explicitly representing the motives and constraints of businesses, households, and government. While the system dynamics approach does not guarantee a more *correct* model, it leads to a more verifiable one.

As do other econometric models, the National Model addresses capital investment, inventory and backlog management, price setting, financial controls, consumption, savings, and participation in the work force. But it differs from other models in its "managerial" treatment of these processes, explicitly representing physical flows of people, equipment, and energy as well as the parallel monetary flows associated with wages, capital investment, and other expenditures.

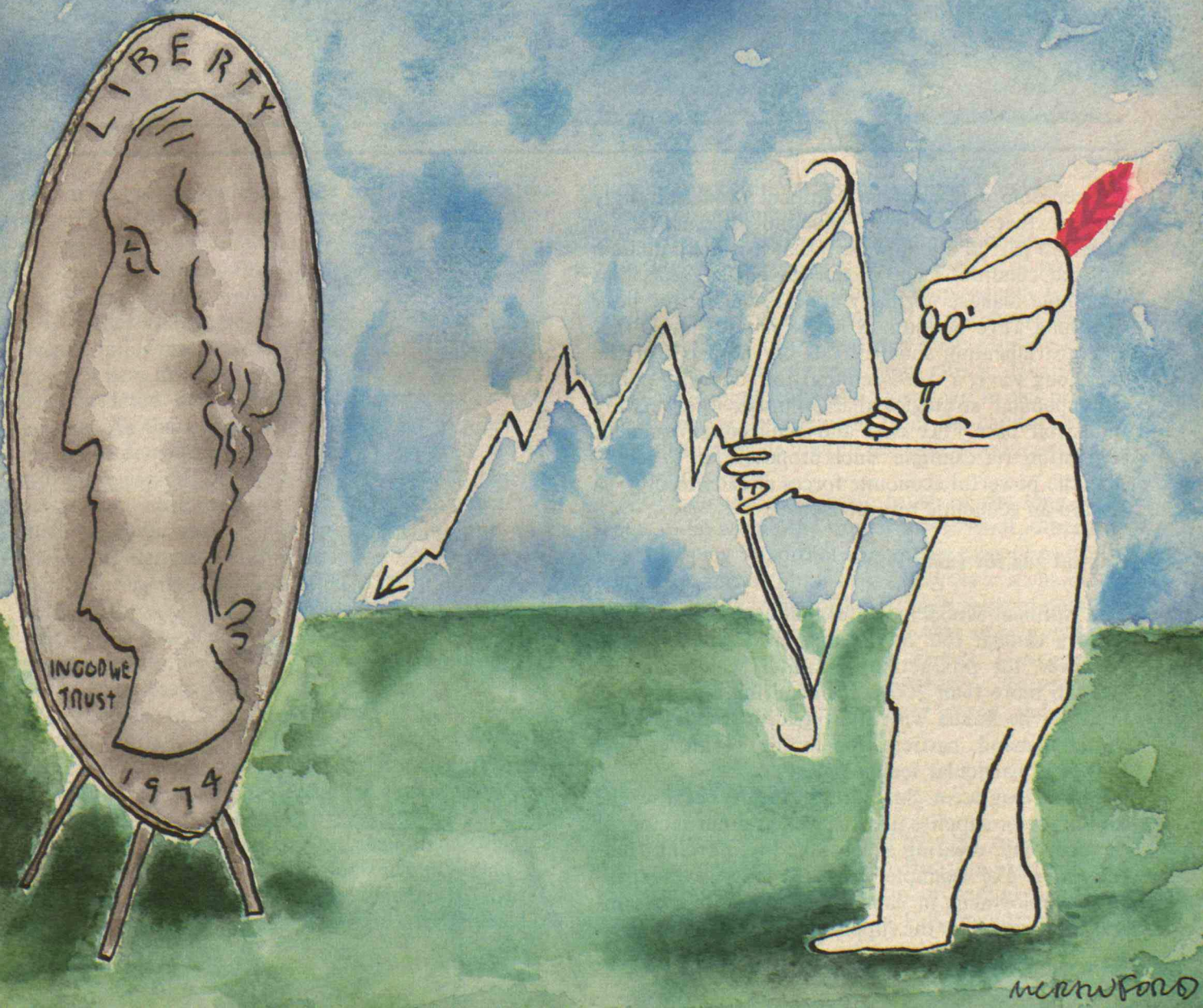
As a result, the System Dynamics National Model can be used to explain basic patterns of economic change such as fluctuations in the business cycle, persistent inflation, and rising government deficits. In comparison, most other macroeconomic models are designed to make short-term predictions of future values of GNP, inflation, productivity, energy use, and the like.

The model shows how interactions of the major sectors of the economy can lead to repeating "long waves" of economic growth and stagnation. It indicates that such a long wave typically endures for approximately 50 years, followed by another of similar duration. Each long wave is characterized by 20 to 30 years of rapid capital expansion supported by new technologies, followed by about 20 years of declining economic performance and innovation. This phenomenon is often called the Kondratieff cycle, after one of its first discoverers, Russian economist Nikolai D. Kondratieff. (In comparison, variables in the production of consumer goods generally exhibit 4-to-10-year fluctuations that correspond closely to the length and timing of conventionally recognized business cycles.)

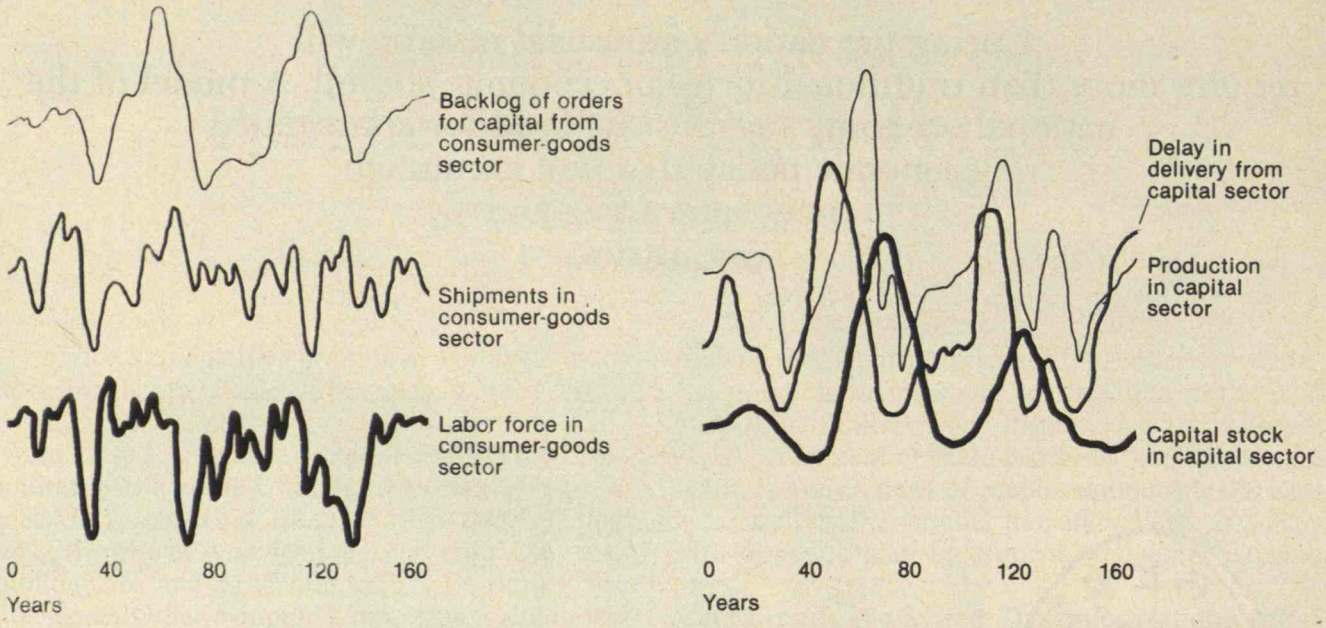
We suggest that there are four phases of evolution in the long wave of capital growth:

- ☐ Concurrent expansion of capital and employment.
- ☐ Continued expansion of capital with relatively little expansion of employment.
- ☐ Little or no capital expansion and a major reduction in employment.
- ☐ Continued decline of capital spending along with gradual restoration of employment growth.

Curing the nation's industrial malaise will require more than traditional forms of economic stimuli. A model of the national economy suggests the need for a farsighted economic policy that will encourage new enterprises and industries.

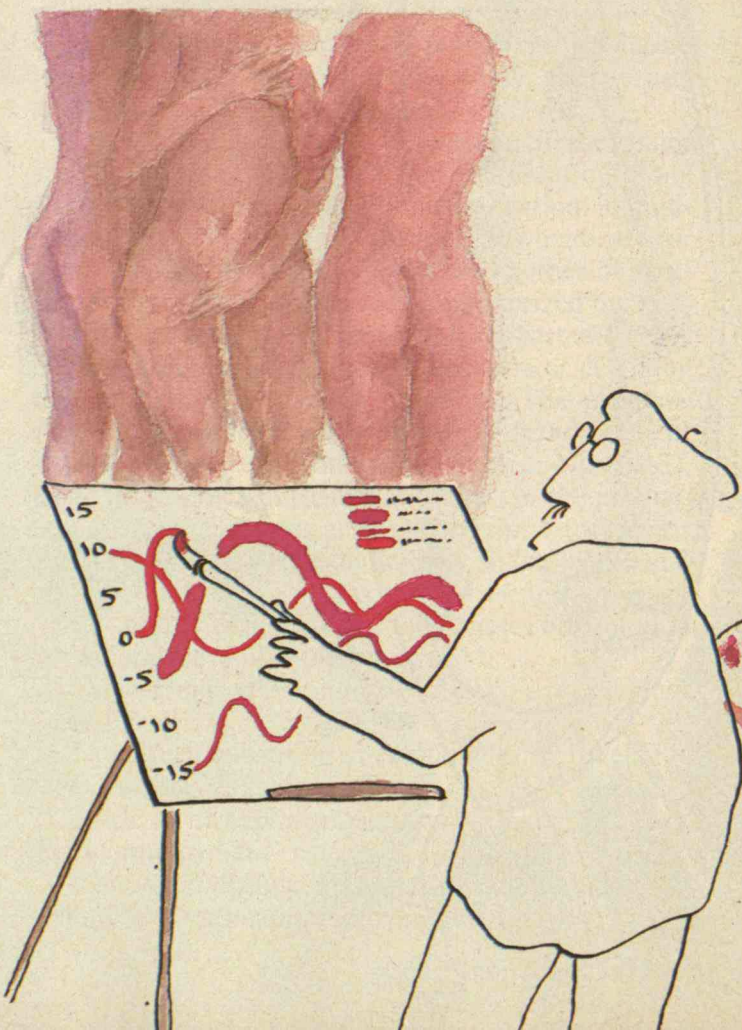


Computer simulation with the National Model showing the different patterns of behavior in consumer goods and capital sectors over a 160-year period. Variables in consumer goods typically exhibit short fluctuations 4 to 10 years long; variables in the capital sector have cycles 40 to 60 years long. Note the three distinct long waves in capital stock that peak at 20, 68, and 125 years respectively, each followed by large contractions caused by overexpansion of capital production capacity.



CHARTS AND DIAGRAMS-OMNIGRAPHICS

Economic data and the National Model strongly suggest that the current economic malaise is an expected part of a long wave—that it is not a unique, isolated condition. The model further suggests that economic malaise normally appears during the peak of a long-wave buildup. A major implication is that reindustrialization should focus on the needs of the *next* long wave, a view seemingly at odds with politically popular strategies that stimulate the *existing* industrial base—tax cuts and reduced government regulation, for example. Such proposals fail to recognize the powerful economic forces already leading us toward an economic resurgence.



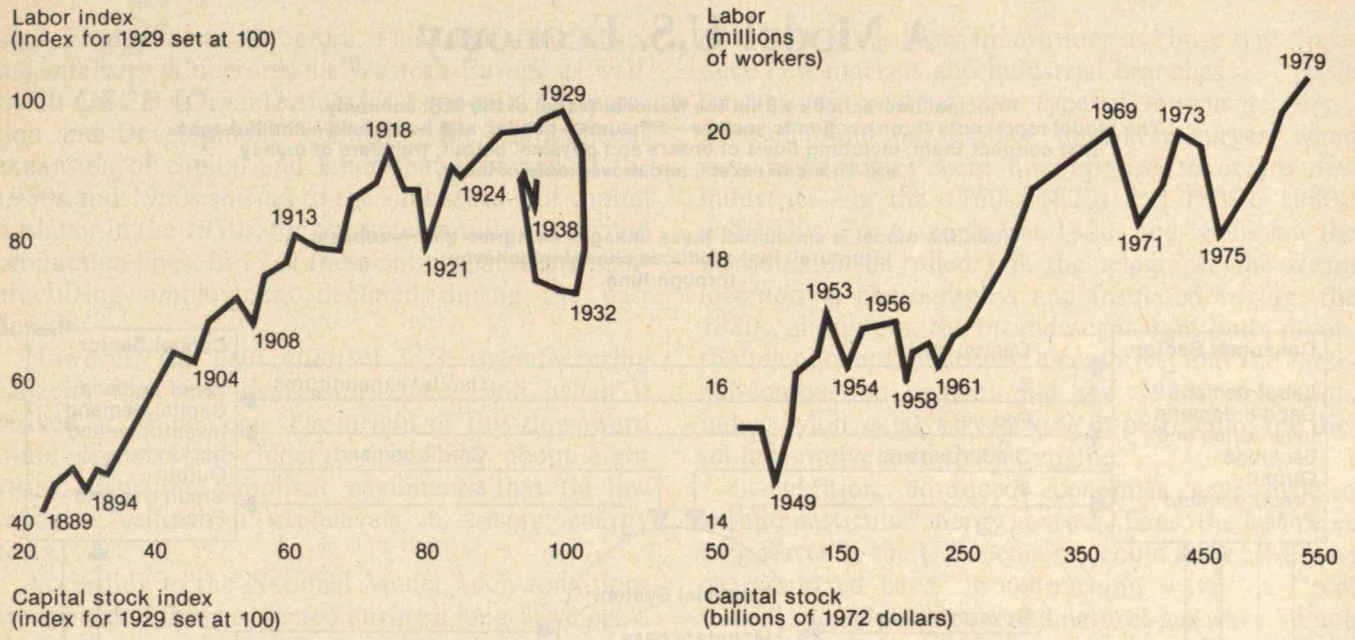
Capital and the Long Wave

The National Model indicates that capital availability plays a central role in the long-wave phenomenon. However, the production of capital, which can rise and fall more than 200 percent during a long wave, need not be linked with shorter-term trends in consumer demand, participation in the workforce, and growth in particular technologies.

These long-term fluctuations result because the capital sector supplies itself as well as other sectors of the economy, creating a "positive" reinforcing feedback loop. For example, during a long-wave expansion, employment in capital-intensive industries increases. Eventually the supply of labor dwindles, driv-

Changes in the ratio of capital to labor in the U.S. from 1889 to 1939. The curve can be divided into four phases: simultaneous expansion of capital and labor (1889 to 1918), substitution of capital for labor (1918 to 1929), zero net expansion of capital with a decrease in labor (1929 to 1932), and rebuilding of labor with a decline in capital (1932 to 1939). These four phases comprise a long wave of economic development. Similar trends have occurred in most developed nations.

Left:
Changes in the ratio of capital to labor in U.S. manufacturing from 1947 to 1979. Since World War II, manufacturing has evolved through two relatively distinct phases: simultaneous growth in labor and capital until 1969, followed by continued accumulation of capital with little increase in employment. The ratio of capital to labor in manufacturing reached an all-time high at the end of the 1970s.



ing up wages and increasing the cost of labor relative to capital. Rising wages encourage the substitution of capital for labor, further augmenting demand for capital and thus stimulating employment in the capital sectors and further tightening the labor market.

Consider the dynamics of capital growth in the decade following World War II. After more than 15 years of zero or negative net investment, capital plant was outdated and scarce; new capital was badly needed. As the capital sector expanded to meet the increased demand, it created demand within itself for still more capital. For example, producers of machinery needed more machine tools and manufacturers of machine tools needed more machines. In this way, increasing demands on the capital sector were mutually reinforcing and generated a very large total demand for capital. (The National Model has shown that major events such as World War II may affect the precise timing of a long-wave expansion but will not alter its basic character.)

In response to such a powerful set of mutually reinforcing stimuli, the capital sector tends to expand beyond long-term needs. Indeed, the National Model has shown that periods of capital expansion, which can last longer than 30 years, typically permit more capital production capacity to accumulate than is needed to meet real consumer demand and replace old capital plant and machinery. The tendency to overexpand the production of capital can be strengthened by buoyant expectations and government policies that attempt to prolong the economic boom.

When the inevitable downturn comes, capital growth gives way to sharp declines in the demand for capital, in productivity, and in employment (*see the decline between years 66 and 72 in the charts on page 58*). Suddenly, the structures that reinforced the growth of capital reverse their effect: deflated demand for capital leads to a slowdown in the production of capital, less demand from the capital sectors, and still further decline in demand. Productivity falters and declines.

Although the most basic cause of the long wave seems to lie within the capital sector itself, other factors may play important supporting roles. For example, the expansion phase of the long wave is characterized by a large influx of labor, high rates of personal saving, and a monetary policy that encourages the accumulation of vital financial capital. The recession phase is characterized by reduced labor demand leading to unemployment, low rates of saving, and policies that discourage capital growth.

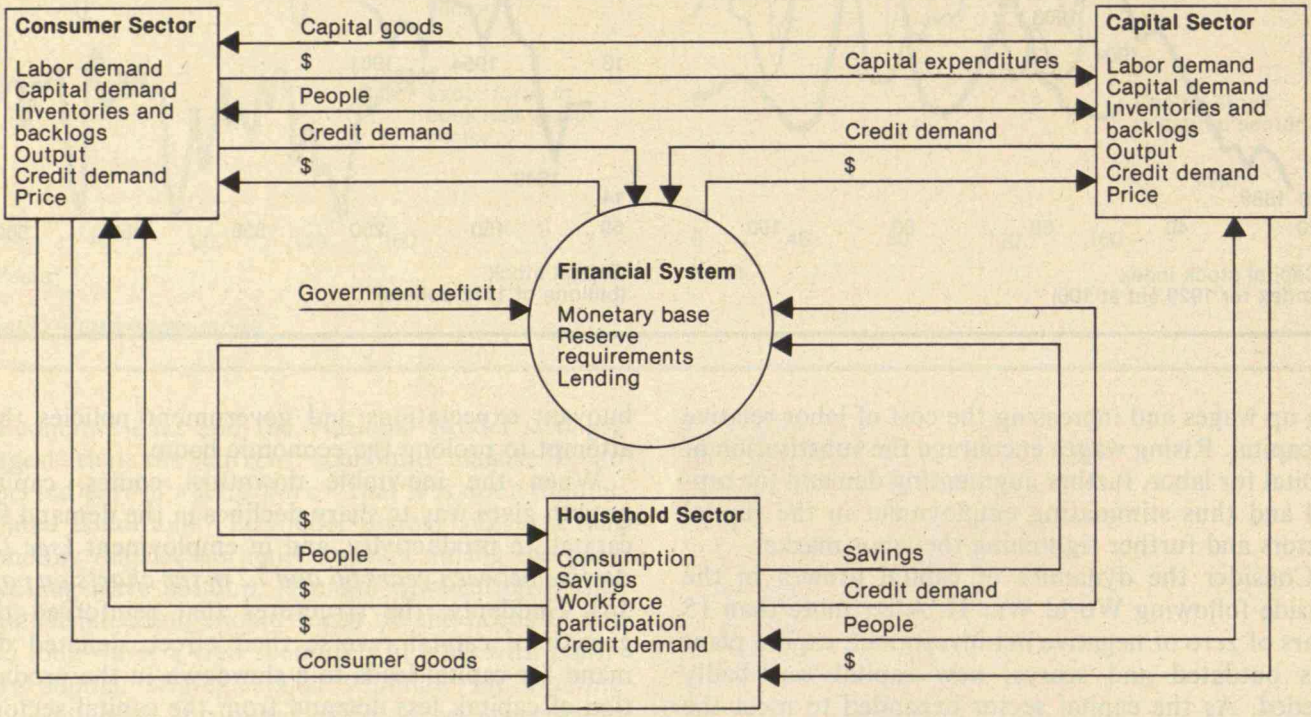
A Capital Shortage Today?

The 1970s were characterized by weak capital investment and decreasing productivity from existing plant and equipment. Yet the ratio of capital plant and equipment to employment in U.S. manufacturing is

A Model U.S. Economy

Principal interactions within the National Model of the U.S. economy. The model represents three economic sectors—consumer, capital, and household—and linkages that connect them, including flows of orders and physical output, transfers of money and financial assets, and movements of labor.

When the model is simulated, these linkages comprise the "feedback structure" that produces changing behavior through time.



THE computer-simulation model of the U.S. national economy constructed by the System Dynamics Group at M.I.T. divides the economy into three major sectors: *capital production, consumer goods production,* and *household.* The capital-goods sector includes commercial construction and the manufacture of capital equipment; the consumer goods sector includes the manufacture of consumer durables and the construction of residential housing; and the household sector addresses basic household consumption, savings, workforce participation, and demand for credit.

The model represents in detail many basic business decisions in the two production sectors. It generates demand for labor and capital; determines production rates; manages inventories and backlogs; sets prices based upon production and overhead costs, demand pressures, and required profitability; determines credit demands; and manages liquidity and other indices of financial performance.

The model can "move" people among the three sectors while generating and tracking the flow of their wages. It also matches flows of capital goods and consumer goods with dollar flows of capital and consumer expenditures. Because of its explicit treatment of monetary and real quantities, the National Model can assess markets for materials and goods, labor, and finance on the basis of both price and availability rather than only price, as do most econometric models. As a result, the model produces long-term patterns of economic behavior undetectable by more conventional models.

Perhaps of more immediate concern for reindustrialization, the National Model simulates the effects of interactions between government and the private-sector responses that produce inflation. For example, results strongly suggest that the inflationary effect of efforts at reindustrialization depend largely on the dynamics involved in the supply of and demand for credit.

Over the last decade, a substantial fraction of the federal deficit has been financed by the Treasury through the Federal Reserve, thereby directly increasing money supply and providing bank reserves for support of additional money and credit. The National Model captures the channels for deficit financing, expansion of the money supply by commercial banks, and consequent inflation.—*N.J.M. and P.M.S.* □

Danger lies in the temptation to choose remedial actions capable only of solving short-term problems.

higher today than ever before. This trend toward capital intensity is mirrored in Western Europe as well. In 20 OECD (Organization for Economic Cooperation and Development) countries, the simultaneous expansion of capital and labor that occurred in the 1950s and 1960s shifted to the substitution of capital for labor in the 1970s; for example, in fully automated production lines. In 17 of these nations, absolute manufacturing employment declined during the past decade.

However, the *utilization* of U.S. manufacturing capacity has been decreasing since 1966, when it peaked at 91 percent. The origin of this downward trend predates the "energy crisis" by about eight years, dispelling simplistic arguments that tie low capacity utilization exclusively to rising energy costs.

According to the National Model, such conditions are typical of those expected during a long-wave peak. Our assessment is consistent with analyses by many economic historians, who propose that the currently developing mix of capital and labor is quite similar to that which appeared during the end of the 1920s (*see the left graph on page 59*).

Innovation and the Long Wave

There are likely to be good times and bad for innovation as the long wave develops. During the downturn of a long wave (phases three and four), economic conditions are uniquely propitious for the implementation of new technologies. The economy has experienced several years of zero or negative net investment; capital stock is old and technologically outdated; unemployment is high and labor mobile. Controlling bureaucracies, once heavy with overhead expansion, have weakened.

In contrast, after the first phase of a new long-wave expansion, opportunities for basic innovation are likely to all but disappear. The economy "locks in" on a particular mix of technologies; in economic terms, an "infrastructure" develops. By the end of the second phase, technological improvements that increase efficiency and allow further substitution of capital for labor are favored over technologies that require wholly new types of capital.

This theory describing the changing climate for innovation during the long wave is consistent with the pattern of basic innovation from 1740 to 1960, compiled by Gerhard Mensch of the International Institute of Management in Berlin (*see the chart on page 62*). He defines basic innovations as those that "produce new markets and industrial branches. . . . Basic innovations create a new type of human activity." Mensch found four distinct "innovation surges" when new technologies were first applied to create new industries—in the 1760s, 1820s and 1830s, 1880s, and 1930s. For example, the 1820s and 1830s saw the introduction of rolled rail, the telegraph, the steam locomotive, photography, and insulated wiring; the 1880s, aluminum, the incandescent light bulb, rayon, the telephone, the electric locomotive, and the internal-combustion engine; and the 1930s, television, radar, nylon, catalytic cracking of petroleum, the diesel locomotive, and the jet engine.

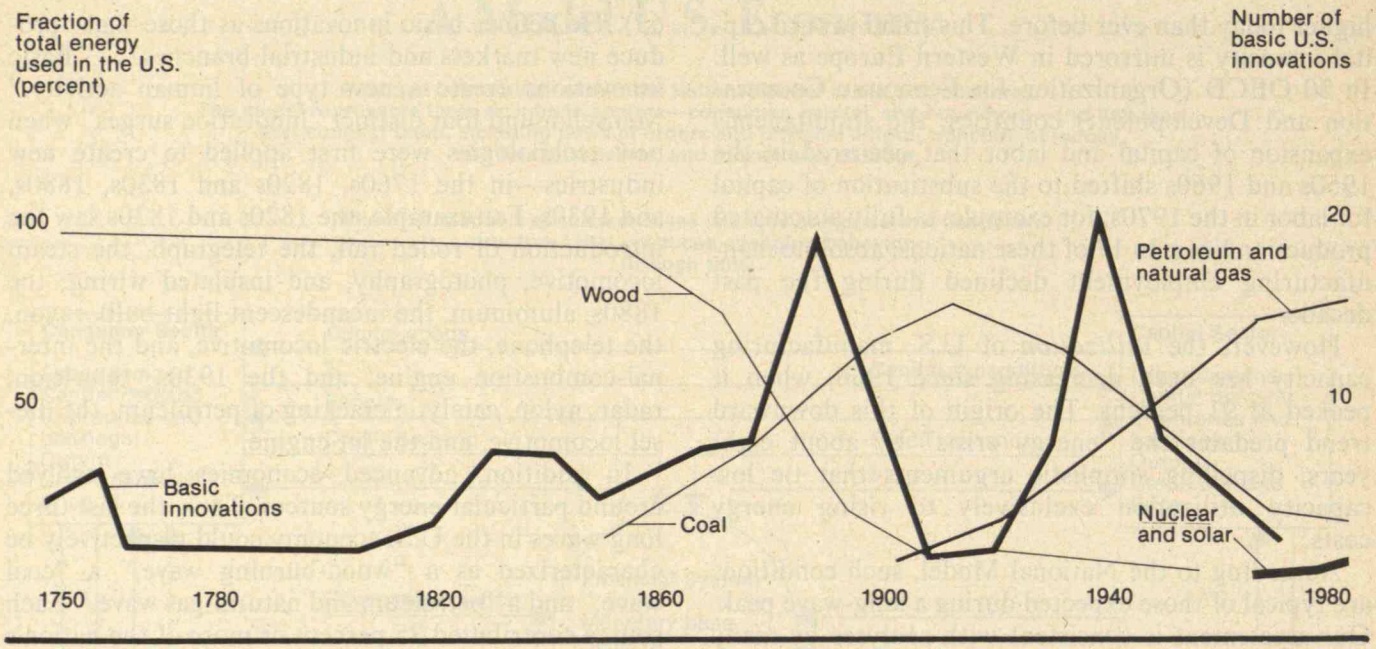
In addition, advanced economies have evolved around particular energy sources. Thus, the last three long waves in the U.S. economy could respectively be characterized as a "wood-burning wave," a "coal wave," and a "petroleum and natural-gas wave." Each source contributed 75 percent or more of the nation's energy during its heyday (*see the graph on page 62*), and each in turn was superceded by the primary energy source of the next long wave.

Apparently the economy develops around particular technological mixes and generates powerful reinforcing pressures that foster a societal commitment to those technologies until diminishing returns undermine incentives for further expansion. (For example, the long wave peaking in the 1930s focused on an infrastructure that included interstate highways, auto dealerships, service establishments, gasoline stations, and revenues from gasoline taxes, which provided revenue for highway maintenance, which in turn encouraged the use of motor vehicles.) The final years of a long wave include profound readjustments and shifts among technologies, industries, and firms. Our economy is only now beginning a transition from one technological base to its successor. The message for today's reindustrialists is clear: no quick economic fix will reestablish the technologies of the 1950s and 1960s. Our "reindustrialization" must focus on the technologies of the *next* long wave.

As the Long Wave Ends

How can policymakers work most effectively with the underlying economic forces to bring about a smooth transition to the coming long wave? Theoretically, appropriate national and corporate policies can facilitate transitions and minimize disruptions and uncertainties. But danger lies in the temptation to choose

Frequency of basic innovations in the U.S. and changes in basic energy sources from 1970 to the present. Four distinct peaks in innovation are evident, each coinciding with troughs in an economic long wave. The periods of increased innovation shape the technological character of the subsequent long wave. Note that the nation appears to be heading toward a new period of accelerated innovation. The U.S. has relied mainly on wood, coal, and petroleum and natural gas for its major energy sources during each of the last three economic long waves. The economy seems to develop around particular mixes of technologies, each with relatively unique energy requirements.



remedial actions capable of solving only short-term problems. Well-intentioned traditional policies such as tax cuts and investment credits, designed to stimulate an economy beset by a business-cycle downturn, are inappropriate for use during industrial stagnation caused by more profound economic forces; they may actually make matters worse over the long term. If capital spending fails to respond strongly to such inducements, the inflationary pressures created by financing the stimulus will further exacerbate the economic dilemma.

Typically, such ill-timed choices may appear to be appropriate and can be politically popular. For example, quotas on imports of Japanese cars might bolster the production of less efficient cars in the United States in the short run, but would ultimately reduce the pressure on domestic automakers to meet competitive standards, thus diminishing choices and reducing U.S. energy efficiency. Similarly, schemes that set minimum prices for imported steel subsidize domestic inefficiency and outmoded production processes.

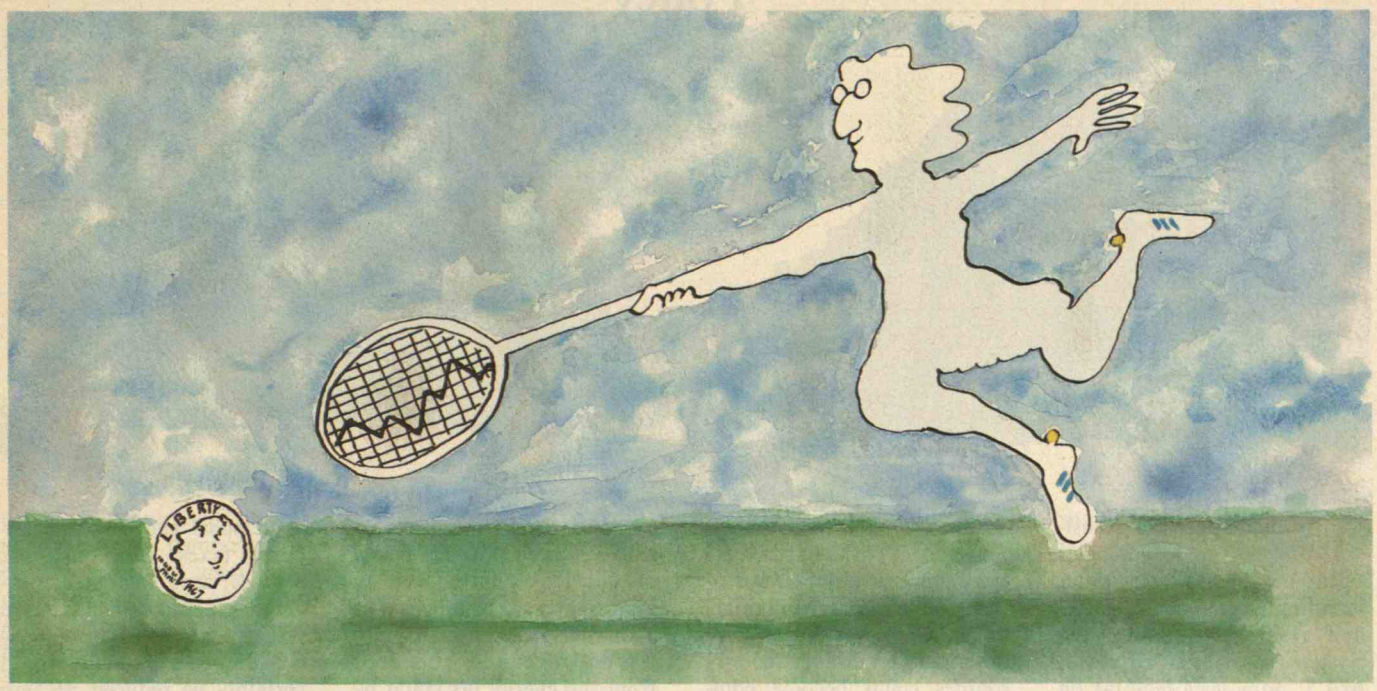
On the other hand, policies that could have beneficial long-term effects are likely to exact some significant short-term costs. For example, liberalization of tax regulations to encourage the growth of new industries and technologies would decrease federal tax revenues in the short run, thereby creating temporary pressures for deficit spending and monetary expansion. Effective policies must focus on the next long-wave expansion, which may not begin for a decade.

General versus Industry-Specific Stimulus

Many studies have shown that relatively small, new enterprises are more effective in generating innovations than larger, more established companies. Thus, we assume that many of the key innovations of the next long wave will be developed by new enterprises. The National Model suggests that the most productive economic initiatives would improve the environment for the growth of new businesses. Traditional stimuli such as investment tax credits and accelerated depreciations are only minimally helpful to such new activities. Over a third of American businesses with less than $5 million in assets report no net income for tax purposes. Therefore, tax deductions are of little or no value to these enterprises. On the other hand, a reduction in the capital-gains tax for investment in new or small enterprises could be very beneficial, increasing the availability of equity capital to these businesses.

How can we identify industries that show long-term potential for expanding employment and capital investment, those that will be on the leading edge of the next long wave? Historical studies of innovation such as Mensch's offer some guidance: technologies central to new expansion usually predate that expansion by many years, existing as technically feasible ideas or inventions awaiting the right economic circumstances. For example, the automobile, television, and jet engine, around which the present long wave

Policies that could have beneficial long-term effect are likely to exact some significant short-term cost.



took shape, were invented many years before they became major factors in the economy.

These observations suggest that the fledgling key technologies of the next long-wave expansion are already among us: alternative energy sources, genetic engineering, and powerful microcomputers. Perhaps we need not anticipate technological breakthroughs, but we must envision new social and economic conditions that would encourage the development of such promising innovations.

One concrete way government can encourage new industries is to identify and resolve contradictory mandates in existing legislation. (The task is complicated because government regulations tend to evolve in a piecemeal fashion over successive administrations and bureaucracies.) For example, rising energy prices, pressures on nonrenewable resources, and environmental concerns have increased incentives for recycling. But federally mandated rate structures for railroads make it less expensive to transport virgin raw material than scrap, thereby discouraging the recycling industry.

A successful national economic policy will appropriately encourage "disinvestment" as well as investment. In *The Zero-Sum Society*, economist Lester Thurow makes this point clearly: "Eliminating a low-productivity plant raises productivity just as much as opening a high-productivity plant. But doing so takes fewer resources. Large investments are not necessary. To close a low productivity plant also makes it possible to move the workers and capital that have been tied up in this activity into new, high-productivity activities. With more people and investment funds, new activities can grow more rapidly."

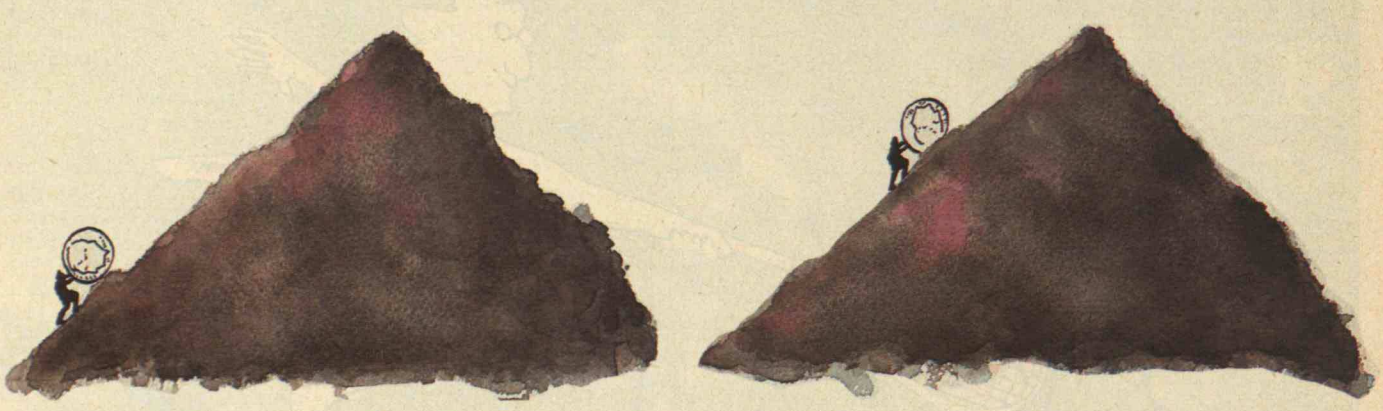
Good macroeconomic policy will also avoid protectionist measures that invite reciprocity by other countries. Pressures for protectionism are likely to be great, increasing as the time for a major restructuring of the economy becomes more obvious. To resist these temptations, we need to establish a clear national vision of longer-term opportunities.

The Financing of Reindustrialization

Mounting pressures for government to relieve declining industries and regions of high unemployment can be expected during the third and fourth phases of the long wave. But these pressures present long-term dangers, especially in the effect of such policies on federal deficits.

Indeed, the federal budget has been in deficit for 14 of the past 15 years. A growing fraction of that deficit has been financed through the sale of U.S. Treasury bonds to the Federal Reserve System. In this process, which is sometimes called "monetizing the debt," the Federal Reserve pays for the bonds by crediting the Treasury with a deposit within the Federal Reserve System. When the Treasury spends the proceeds of such bond sales, commercial banks come to hold the deposit obligations on the Federal Reserve bank, and

One Self-Financing Reindustrialization Policy



To encourage the transition to the technologies of the next long wave without entailing large federal deficits and resulting inflation, the Systems Dynamics Group at M.I.T. proposes a high tax on petroleum and natural gas, both domestic and imported. The tax would increase national energy prices and create strong incentives for conservation and a price "umbrella" under which a wide range of potential renewable energy sources could become commercially profitable. Model simulations suggest that an appropriate tax might be at least $30 per equivalent barrel of oil, to be introduced in gradual steps over a period of about five years.

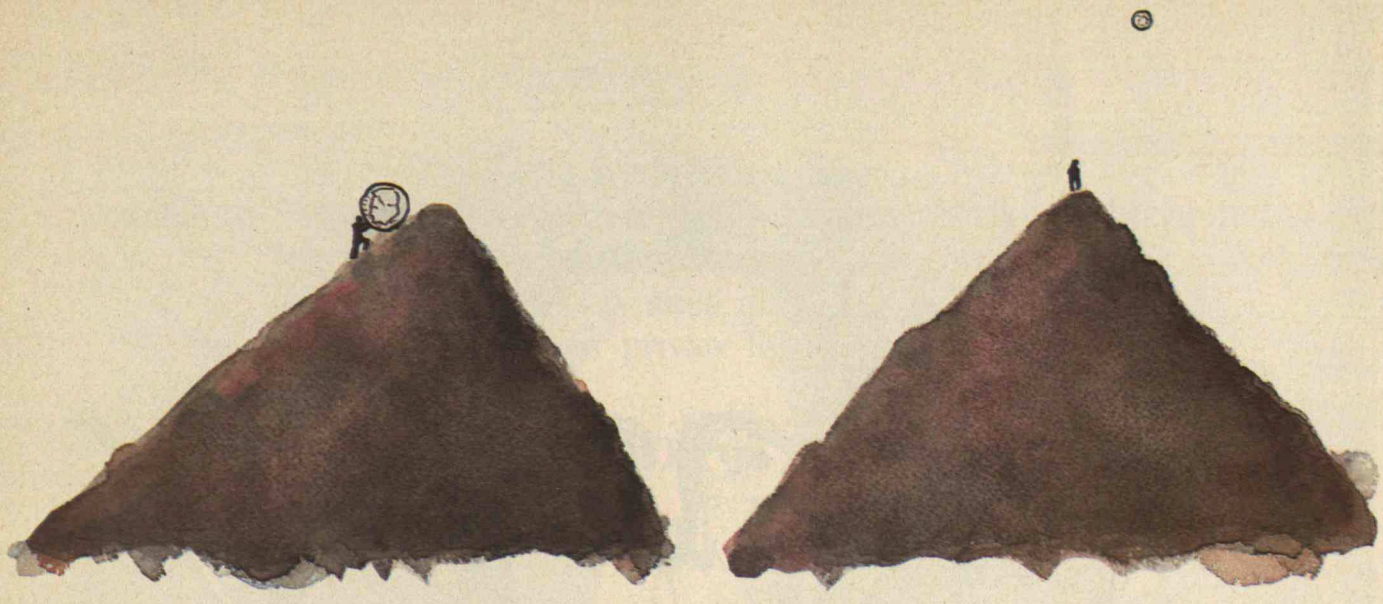
The revenues collected from the energy tax could be returned to the economy as reductions in other taxes, such as personal and corporate income taxes (the only tax sources large enough to provide a potential offset). Based on present levels of energy consumption (which would certainly be reduced because of increased energy prices) and a very conservative $20-

they in turn use the deposits as bank reserves to support additional lending activity. As these new funds are lent by commercial banks out into the private economy, the money supply expands and new purchasing power is created. But the availability of money increases faster than production capacity, putting upward pressure on prices, the dollar value of assets, and debt levels because of the greater asset values of collateral. The resulting inflation then reinforces itself by creating pressure for still more money and borrowing.

The Federal Reserve system now holds roughly 15 percent of the outstanding Treasury debt sold to finance government deficits. While this percentage may sound small, it implies that throughout the 1970s, Treasury bond sales to the Federal Reserve system have been sufficient to expand the credit base of the economy—and thereby money supply, purchasing power, and inflation—by almost 10 percent per year.

The National Model shows that the interactions of capital formation and additional government expenditure through stimulus programs can become especially inflationary during a period of excess capital plant. Government spending that results in the creation of new money and credit can have two different effects: greater demand for goods and services (thereby putting upward pressure on prices and causing inflation), and increased financing of new capital equipment, which could expand productive capacity and provide a greater flow of goods to counter inflation. But the National Model indicates that with today's excess capital plant and low return on investment in many industries, additional money is likely to raise the demand for goods and encourage speculation to a much greater degree than it stimulates real capital formation. Thus, government stimulus programs and deficit spending today are likely to contribute to tomorrow's inflation much more than to productive investment. In turn, expectations of high inflation can create additional incentives for early consumption calculated to beat price increases, diminish incentives to save, and further reduce investment because of high interest rates and economic uncertainty.

The achievement of an economic policy that supports long-wave economic development without producing inflation will not be easy. Some guidance in the difficult task of identifying industries and technologies with significant long-term potential comes from Japan, where a successful (although not perfect) working relationship between industry and government has led to the identification of "sunrise" industries (those with future potential) from "sunset" industries (those on the decline). That nation has



per-barrel equivalent on oil and gas, such compensating reductions would amount to nearly half the total of all personal and corporate income taxes paid in the United States. Such a reduction in corporate income taxes would certainly help ease inflationary pressures, and the reduction in personal income taxes would encourage general demand for consumer goods and services. The promise of greater take-home pay could also spur increased participation in the labor force, reducing unemployment.

This sort of innovative energy policy embodies several characteristics desirable in national policies. It is self-financing: the energy tax "pays for" income-tax reductions with no net addition to the federal deficit. The policy is unambiguous and relatively simple to administer: it would not necessitate a large new bureaucracy. And it is not punitive but uses the price mechanism to influence the millions of daily decisions that comprise energy demand and supply.—*N.J.M. and P.M.S.* □

been able to reach reasonable degrees of consensus and had a significant measure of success in shifting the emphasis of its technologically based industry. In a pluralistic society such as the United States, government cannot dictate the allocation of resources. Nonetheless, open discussion among business, government, and labor leaders should be encouraged to focus national attention—and imagination—on the next expansion.

We view the fundamental challenge posed by reindustrialization as the need to evolve a new kind of economic intervention. Can we move beyond merely reacting to the symptoms of stagnation? In complex economic systems, the most effective policy changes are not likely to be obvious responses to pressing problems, but rather those that emerge from an appreciation of the longer-term causes of those problems. Successful policymakers will work *with* those forces rather than *against* them. The effort will require innovative thinking and persistent, energetic sponsorship. But who ever said that reindustrialization would be easy?

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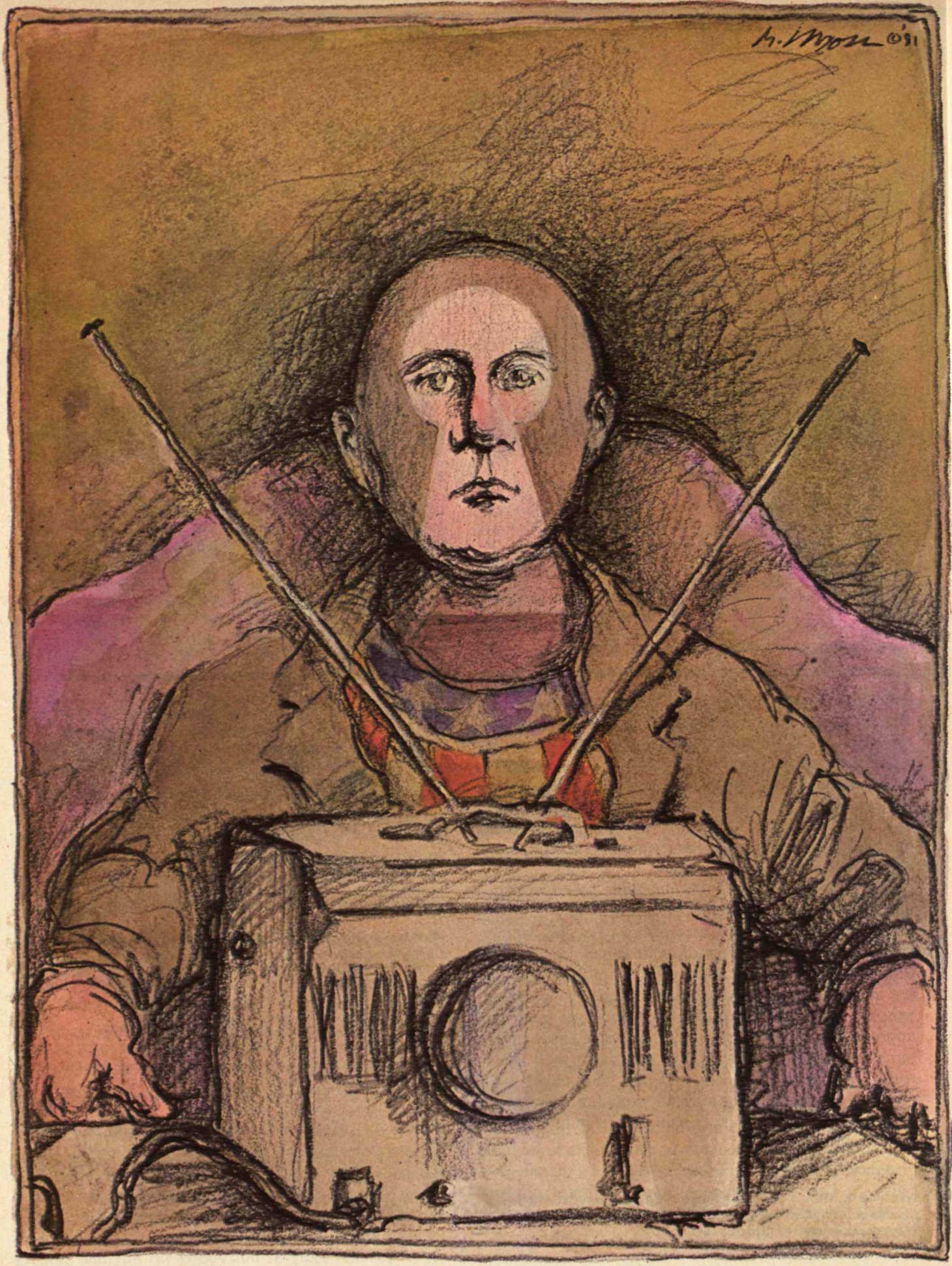


Interactive media will soon enable us to communicate with virtually anyone from a home terminal. But that useful electronic network could also let all kinds of unwanted intruders into our private lives.

Protecting Privacy in the Age of Hometech

by Deanna C. Nash and David A. Bollier

THE television used to be simply a device for bringing news and entertainment from the outside world into our living rooms. But now the family television is being hooked up to other basic information tools—the computer, cable, and telephone—creating an entirely new technology of interactive home media, or "hometech," capable of transmitting information out of, as well as into, homes.

While cable is still used primarily for commercial programming, cable companies are exploring other services that will transform cable into a virtual highway for valuable cargoes of personal data. This cargo will include electronically stored news, classified ads, Yellow Pages, weather reports, and stock quotations; interactive transactions such as banking, shopping, airline reservations, and remote medical diagnosis and advice; monitoring of home security and energy use; opinion polling; and communications from individuals working at home.

The advent of hometech is creating a dramatically different context for our lives. Distinctions among industries—television, computer, telephone—are blurring. Political participation takes on new meaning as it becomes possible to poll citizen opinion quickly and widely. New educational possibilities beckon as vast electronic "libraries" become accessible. The technology's potential is clearly enormous: by one estimate, there are at least 65 different services possible through hometech systems. Depending on the technology, delivery costs, and consumer demand, vast new markets await hometech entrepreneurs. But the very scope and volume of information involved in these systems also create serious, poorly understood risks for the privacy of individuals and businesses that use them.

No Place Like Hometech

The traditional concepts and language of individual privacy do not account for the new realities of interactive home media. For example, how are we to interpret the Fourth Amendment protections against unlawful search and seizure in the context of two-way cable, videotex, and other interactive systems that can collect countless streams of data about a person, compile that information, store it, analyze it, cross-reference it, and use it in manipulative ways without the consent of the individual or the supervision of government or the courts? What does the common-law notion of the "right to be left alone" mean when it involves hometech?

The privacy dangers of hometech are largely unrecognized. This is not surprising; the general public hardly knows what interactive technologies are, and even cable television, the most developed hometech industry in the United States today, downplays the issue. One official of the National Cable Television Association reportedly wants his group to work on the issue "quietly." Another NCTA official concedes that the privacy dangers are real, but notes that the

Companies are exploring services that will transform cable into a virtual highway for valuable cargoes of personal data.

issue "is not being dealt with on an industrywide basis because it hasn't demonstrated itself as a burning fire yet. But it will." As for drawing up voluntary guidelines to assure that the issue is given due recognition, Gustave Hauser, president of Warner-Amex, speaks for many in the industry when he argues that privacy guidelines are "possibly premature" and that cable companies "should just be left alone for a while to creatively find our way to provide what people want."

In the programming realm alone, intense competition is brewing among commercial television, cable, subscription TV, multipoint distribution services, and eventually, lower power VHF and UHF and direct broadcast satellites. In this race where the stakes are high, the technological pace swift, and the capital investments huge, it is easy to see how concerns for consumer privacy might take a back seat. Moreover, because future services and markets are uncertain, it is all the more difficult to devise effective privacy safeguards.

Nevertheless, the interactive home media industry has strong incentives for dealing with privacy issues immediately. Privacy protections designed into the system would be less costly, less complex, and more effective than any measures adopted later. And privacy safeguards are of concern not only to consumers but to businesses as well: companies that use telecommunications systems need to be assured that their business data are secure, and vendors, to stay in business, must be able to provide that assurance.

What people want in the way of interactive home media is a matter of speculation. But their desire for—and right to—privacy is much more certain. The urgent question, therefore, is how to assure individual privacy as the new technologies develop. The first task is to understand what the new technologies can do and how these systems can violate individual privacy in new and unforeseen ways. If we are to continue to enjoy the privacy we now have, Congress, the courts, regulators, industry, communities, and citizens' groups must create new definitions of protectable interests, legal concepts, and institutional safeguards. Because the technology and the industry are changing rapidly, some recommendations must be tentative. But to do nothing is to ignore privacy concerns until it is too late.

Four Ways to Expose Yourself

Consumers risk four types of exposure with interactive home media: intrusion, interception, misuse of information, and aggregation of individual or household information.

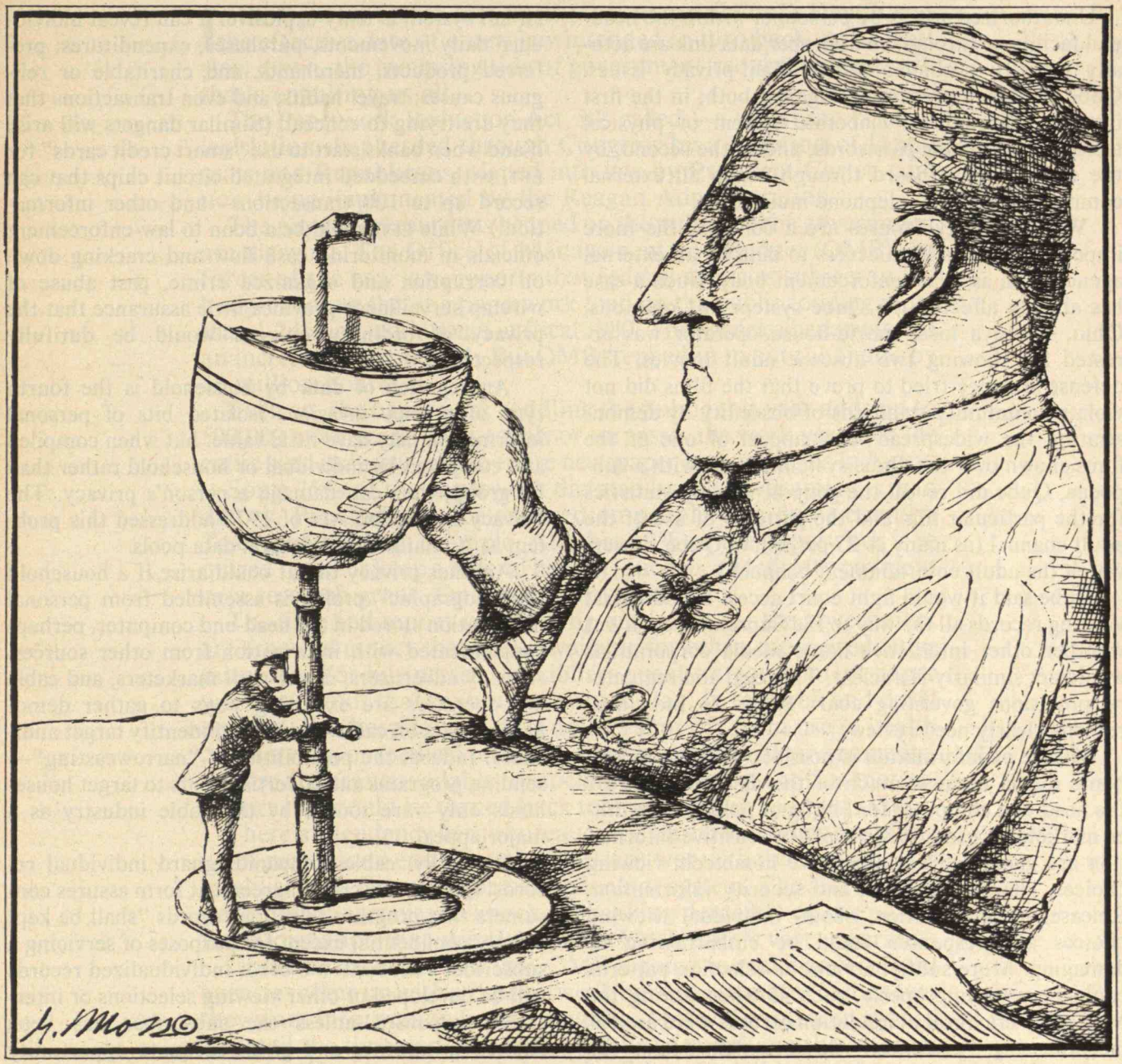
Intrusion is made possible by the constant electronic surveillance provided by some interactive cable systems. For example, Warner-Amex's Qube system in Columbus, Ohio scans user households every six seconds to record such information as whether a household's TV set is on or off, the integrity of the receiver, the channel being viewed, and the last response button pressed. Other hometech systems use the same polling technique to detect fire, smoke, sound, and movement, monitor energy load, and transmit calls for medical help. Before sending out an alarm, the system repolls the terminal to confirm the signal and then transmits to the central computer any additional relevant information such as a user's medical history, special architectural features of the house, or the presence of hazardous materials.

Ironically, home security systems may themselves become intrusive. For example, a utility company might find it valuable to know about a consumer's energy load not just to regulate the household's heat, as requested, but to develop energy policies that affect that household. The utility could then correlate its publicity campaigns with energy use or determine who is cooperating with conservation programs.

Another form of intrusion involves the undesired reception of objectionable, obscene, or unwanted programs. Such intrusion became an issue for cable TV when some operators began to offer "adult" channels with sexually explicit movies. Qube maintains two safeguards: viewers may choose to have the channel entirely blocked, or they may install a special terminal with a lock to control reception of the adult channel. Other undesirable reception will occur with videotex, which will offer consumers a variety of information services through a single channel, with no simple way to edit out offensive information. Already there are private efforts to ban violent, sexually suggestive, or otherwise controversial subjects from television and school libraries. With the greater diversity of information available through videotex, the range of possible political or moral objections will multiply.

Interception can occur when an outside party eavesdrops on private communication to the head-end (central cable company) computer. Such interception can occur at several points in the system: during transmission from a home console to the head-end computer; and at the head-end, through unauthorized tapping into data, an improper communications link,

Sensors that detect the presence of an intruder in a home could also be used to monitor a homeowner's movements.



or authorized access by an outside agency such as a law-enforcement body.

For example, when a home interactive cable user sends an electronic message to the head-end computer, the message, along with a code number identifying the originating terminal, can be intercepted below the first "bridge gate controller," which controls the upstream and downstream direction of messages. Before this point there are as many as 256 terminals, any of which could potentially pick up a weak signal that might flow back downstream. While normal terminals are designed to ignore such signals, a specially designed terminal could intercept them. This is improbable, considering the necessary effort and expense, but the incentives for interception will grow as more kinds of information are sent over the system. Although a microprocessor-driven scrambler within the home terminal could eliminate this problem, the question is how much protection is needed and who should pay for it.

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Unauthorized access by personnel within the head-end facility or through an improper data link are actually security problems rather than privacy issues. Qube has taken precautions against both: in the first instance, through an elaborate system of physical locks and computer passwords, and in the second, by the use of a patchboard through which all external communications via telephone must come.

While security failures are a concern, the more important issue is legal access to data by an external agency such as a law-enforcement body. Such a case has already affected the Qube system in Columbus, Ohio, where a local movie-house operator was arrested for showing two obscene adult movies. The defense attorney tried to prove that the films did not violate community standards of obscenity by demonstrating the widespread local appeal of one of the films shown over the Qube system. Faced with a subpoena, Qube did reveal the general viewing statistics for the particular film and the patterns of use of the adult channel (as many as 25 percent of Qube viewers watch the adult entertainment channel.)

Qube said it would fight court access to individual viewing records all the way to the Supreme Court, but whether other interactive home media corporations would act similarly is unclear. The legal and regulatory provisions governing court access to individual records clearly need review.

Misuse of information is possible with interactive home media because much of the data collected by the head-end computer for billing or polling have other marketable uses. Three types of sensitive information are generated by interactive hometech: viewing choices, viewer responses, and security information. Release of information about individual viewing choices and responses could be embarrassing or damaging. More subtly, a viewer's selection patterns could be used improperly, such as when during the McCarthy era library circulation records were used as incriminating "evidence." Sensors that detect the presence of an intruder in a home could also be used to monitor a homeowner's movements. Personal information supplied during medical emergencies or fires could be used by insurance companies to surreptitiously raise risk factors and thus premiums.

As the diversity of hometech services grows, privacy dangers mulitiply. For example, electronic funds transfer (EFT) holds huge potential for abuse. Major studies are now underway to test banking and billing from remote terminals for eventual incorporation into hometech systems. The information shuttled through an EFT system is truly explosive: it can reveal individuals' daily movements, purchases, expenditures; preferred products, merchants, and charitable or religious causes; travel habits; and even transactions that they are trying to conceal. (Similar dangers will arise if and when banks start to use "smart credit cards" for EFT, with embedded integrated circuit chips that can record up to 100 transactions—and other information.) While EFT would be a boon to law-enforcement officials in monitoring cash flow and cracking down on corruption and organized crime, past abuse of wiretap surveillance provides little assurance that the privacy of ordinary citizens would be dutifully respected.

Aggregation of data by household is the fourth type of privacy invasion. Isolated bits of personal information may have little value, but when compiled and compared by individual or household rather than by group, they can damage a person's privacy. The Privacy Protection Act of 1974 addressed this problem as it relates to the federal data pools.

Another privacy threat could arise if a household "psychographic" profile is assembled from personal information stored in the head-end computer, perhaps supplemented with information from other sources. Already advertisers, direct-mail marketers, and cable TV operators are exploring ways to gather demographic data on cable viewers and identify target audiences. Indeed, the possibilities of "narrowcasting"—sending programs and advertisements to target households only—are touted by the cable industry as a major appeal.

Generally, cable companies guard individual records. Qube's subscriber agreement form assures consumers that program-selection records "shall be kept strictly confidential except for purposes of servicing a subscriber's account. No other individualized records will be developed of other viewing selections or interactive responses unless the subscriber has been advised in advance and given adequate opportunity not to participate." And the cable press, mindful of possible abuses, devotes considerable news space to the problems of "audience documentation."

But cable companies could increasingly be tempted to sell personal data to third parties as home interactive services expand in both size and scope. Once two-way cable systems and other interactive home media services become common, it will be simple to "rummage through" the available demographic data, which would be invaluable to advertisers and others. Four of the major rating firms—Nielsen,

Battling the Paper Pile

In the fight on forms, last April 1 was no April Fool's Day. It was the effective date of a new law intended to turn back, or at least slow down, the mounting tide of government-required paperwork that's engulfing us all.

The Paperwork Reduction Act, it's called—a bipartisan piece of legislation shepherded through Congress by a coalition of Democrats and Republicans, signed into law by President Carter, and now being implemented by the Reagan Administration.

The paperwork burdens heaped on the public by the government are dizzying. The Office of Management and Budget (OMB), enforcer of the new law, reports that federal agencies subject to the budget process thrust a paperwork load on the public totaling more than 1.2 billion work hours in fiscal 1980. The agencies had projected an increase in fiscal 1981. But OMB stepped in to cut the figure by 48 million hours.

Even so, the paperwork saddling the public this year adds up to 590,000 work years. That equals or surpasses the work years for the entire steel industry, or the entire newspaper and magazine industry.

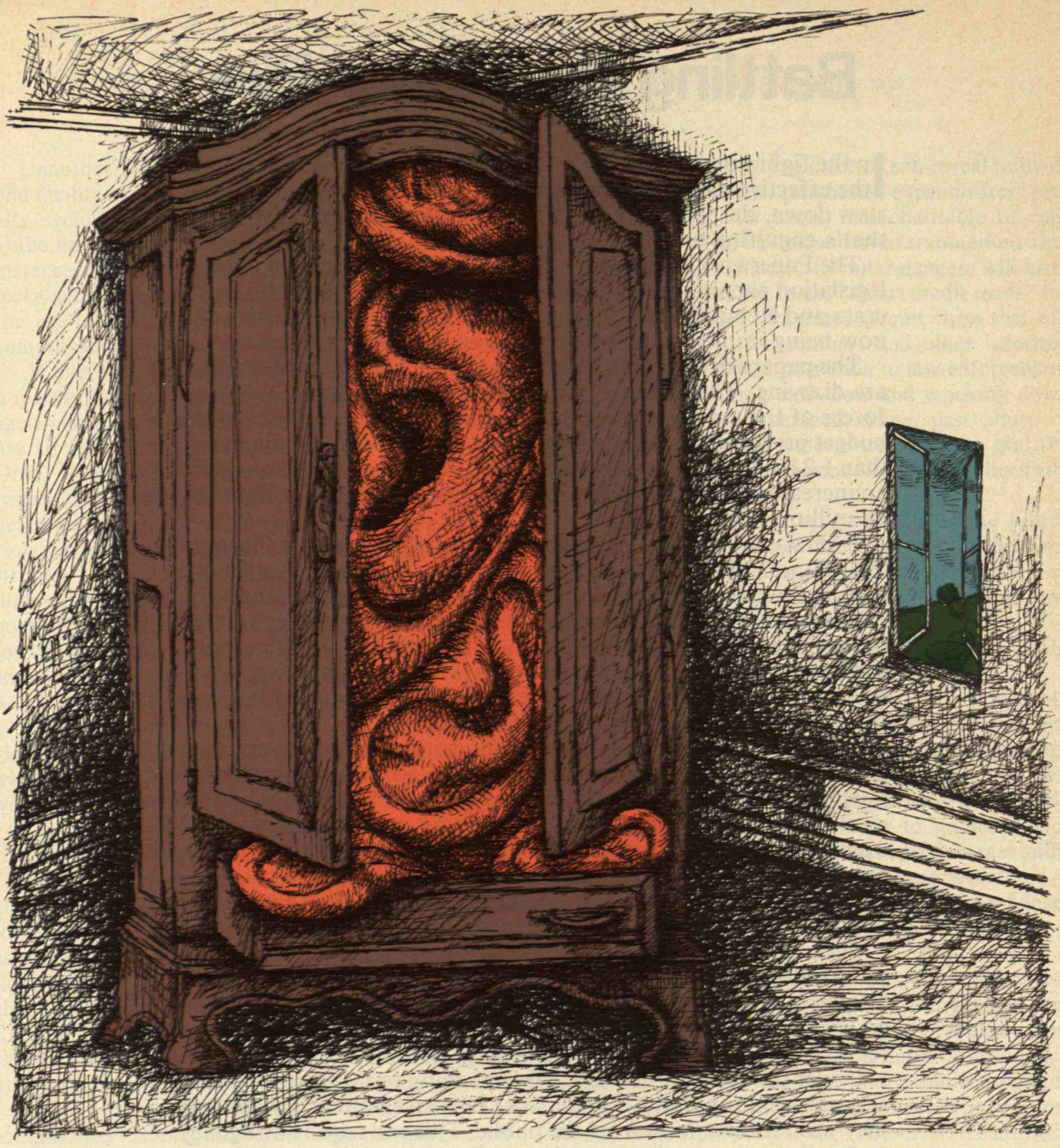
Some 75% of the paperwork dictated by the government is mandatory. Penalties may be assessed on people who don't comply. Tax reporting is an example. Another 19% of the paperwork is required to get or keep a federal benefit, such as a Medicare payment or a research grant. Only 6% is voluntary.

The time and money spent filling out forms for the government are time and money that are unavailable for other, more productive purposes. For businesses, the dollars spent on government paperwork are funds that cannot be invested, say, in research and development. For hospitals, they're dollars shut off from use in health care services or medical research. For state and local governments, they're dollars unavailable for social services—or, for that matter, dollars that could be turned back to the people in reduced taxes.

There's a tendency in the bureaucratic burrows to view the piling up of paper as an end in itself. OMB is at war with that notion. It is establishing a federal information locator system. The aim is to get government agencies to knock off making demands on the public for information that already exists in Uncle Sam's vast apparatus.

Under terms of the new law, OMB is going to make government agencies come up with a " paperwork burden estimate " whenever they want information from the public. This will require an agency to detail the time and cost to the public of supplying the information, justify why it is needed, and tell how it will be used.

Come the first of next year, any government request for information must carry an OMB "control number." If there's no such number, you can ignore the request. Just toss it in the wastebasket.



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Arbitron, Gallup, and Media Statistics—"are showing an interest in cable TV as a possible source of new business," says Maurine Christopher of *Advertising Age*. "Segmenting the market" would be child's play and particularly useful to direct-sales marketers because the consumer would be able to order a product immediately after an advertisement is aired. "There will be no question, under those circumstances, as to whether a commercial is effective," notes John E. O'Toole, president of Foote, Cone, and Belding, an ad agency.

Legal Threads and Patches

Traditional privacy protections such as the law, regulations, voluntary industry guidelines, consumer education, and technical devices are ineffective in dealing with the new dangers of hometech. Accordingly, we must devise a new legal framework that reflects the altered social circumstances. Protectable privacy interests must be identified, research must show how interactive home media might violate those interests, and effective safeguards must be created.

Isolated bits of personal information may have little value, but when compiled, they can damage a person's privacy.

Privacy law is, according to Harvard Law School Professor Arthur R. Miller, "a thing of threads and patches." The imagery tells the story: privacy has been a well-accepted concept in search of a precise legal formulation. The effort to nail down a specific legal doctrine has been repeatedly confounded by the evolution of technology, which creates new and unforeseen threats.

The first landmark attempt to define privacy rights came in 1890, when Louis Brandeis and his law partner Samuel Warren wrote a classic law-review article, "The Right to Privacy." The catalyst was a series of technological developments: the telephone, the microphone and audio recorder, the camera that could take "instantaneous photographs," and the use of these inventions by newspapers. Warren and Brandeis explained how common law secured "to each individual the right of determining, ordinarily, to what extent his thoughts, sentiments, and emotions shall be communicated to others." But the common law was no longer adequate, argued Warren and Brandeis, because "the recent inventions and business methods" created the possibility of new abuses. To establish a new conceptual framework, they compared privacy to property that outsiders might trespass upon. Unauthorized intrusion into a person's privacy therefore could be prosecuted under a tort of trespass and appropriate sums awarded for mental pain and distress.

For the next 70 years, the legal history of the concept of privacy was largely a matter of case law, as the courts wrestled with the limits of acts that represented invasions of privacy and mediated the conflicting interests of individuals versus corporations and government. However, since 1966 six major legislative acts that deal with privacy have been enacted: the Freedom of Information Act of 1966 amended in 1974, the Omnibus Crime Control and Safe Streets Act of 1968, the Fair Credit Reporting Act of 1970, the Family Educational Rights and Privacy Act of 1974, the Privacy Act of 1974, and the Tax Reform Act of 1976.

The two most significant laws for privacy and interactive home media systems are the Omnibus Crime Control Act and the Privacy Act of 1974. The former deals with electronic surveillance and sets forth the circumstances by which one can legally gain private information about an individual or group. Its principles and provisions might well be extended to cover the interception of data and messages from computer terminals within a public information utility system.

The Privacy Act of 1974 addresses the rights of individuals with regard to personal data contained in federal data banks. Its principles and provisions might also be extended to include *privately* owned pools of data about individuals, since the potential dangers are nearly identical.

Perhaps the most significant affirmation relevant to the hometech industry was that individuals have the right to know what personal information is in a data bank and to correct any inaccuracies. Second, the type of information that a data handler can collect about an individual and how that information can be combined with other data bases is restricted. Third, information handlers have a fiduciary responsibility to meet the law's provisions. Accountability is served in part through the individual's right of access, but civil measures also deter irresponsible use of personal data. (For example, misdemeanor criminal penalties can be imposed for willful or intentional violations.)

The 1974 law also established the Privacy Protection Study Commission to report on the act's implementation and other privacy areas that need to be addressed. A major finding of the commission's 1977 report was that the law did not address technological developments—such as interactive home media—that create the possibility of new privacy abuses. The commission noted two areas that especially need more specific legal provisions. First, explicit regulations or guidelines for protecting privacy during routine information-gathering procedures are needed. Although systems such as Qube have begun to address this area, further efforts must be made by cable operators.

A second concern was the informal collection and sharing of information among organizations. Currently there is little legal protection for the transfer of personal data that are not explicitly confidential. For example, the Qube system may collect information of value to its parent companies, such as American Express. New laws or regulations, or at least immediate voluntary industry guidelines, would help curb such uses of information. The commission also pointed out that the enforcement mechanisms of the Privacy Act are not very effective. Not only are the penalties low, but it is difficult for an individual to prove unauthorized or injurious disclosure of information, especially when more than one vendor is involved.

Thus, legal protections are incomplete and rapid technological development exacerbates the problems. Although recent federal legislation offers a valuable beginning guide for private industry, explicit policies

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and guidelines initiated either by the industry or federal regulatory and legal agencies are needed.

Corporate Policies and Regulatory Possibilities

There is a general lethargy within the hometech industry with regard to privacy issues. Although some companies such as Warner-Amex have made some voluntary privacy provisions in their contracts, other companies, especially those in the videotex field, have shown little inclination to explore precautions or draft company or system guidelines.

No community or individual subscriber should affiliate with a hometech system without knowing how individual privacy rights will be treated. Specific provisions consistent with the general principles affirmed by the Privacy Act should be included in the franchise agreement between a cable company (or other interactive system) and a community and in the agreements signed by subscribers. For example, the cable company should agree to use individual customer information only for billing and the stated purposes, such as security monitoring. No disclosure of subscriber mailing lists should be made to third parties without the full understanding and consent of the customer.

Cable operators will want to collect statistical aggregations of audience preferences for programming purposes, but this information should be monitored only with explicit approval and must in no way reveal the identity or preferences of individual subscribers. Provisions should also be made for subscribers to view their own records, and companies should destroy computer records of viewing patterns after a reasonable period of time. The franchisor should agree to some financial penalty for a breach of these contractual responsibilities.

Hometech system capabilities will vary from locality to locality, so local government is the logical and primary body to monitor and enforce systems' regulations and contracts. Unfortunately, many localities are unfamiliar with the issues, so federal and state agencies should adopt minimal privacy standards.

Individual companies, for their part, should create formal policies on confidentiality and computer security and initiate a more spirited industrywide discussion of privacy issues. No single segment of the hometech industry can consider its technology in isolation from the entire system: interconnections between vendors are great, and responsibility for privacy should not be allowed to slip between the cracks. Only by looking at the system as a whole can consumer interests be identified and effective precautions taken. Common carriers, head-end computer operators, independent information providers, and merchandisers and advertisers should be especially concerned.

Privacy on the Block

The hometech industry is in such flux and the technology evolving so rapidly that new laws or regulations—unless they are developed on firm conceptual bases—might be ineffective and inhibit the advancement of the technologies. Yet to ignore privacy concerns until the market stabilizes is no solution either.

Letting the "free market" decide, regrettably, is favored by many in the industry and by two Federal Communications Commission staff members, James A. Brown, Jr. and Kenneth Gordon. In a recent paper, they rely on the classic competitive model to provide a theoretical economic framework for protecting privacy, which in effect legitimizes and encourages increased access to private information.

Brown and Gordon's proposal has a strong but specious appeal. They ask us to view private information as an economic good "insofar as resources devoted to the production of privacy must be taken from elsewhere. That is, more privacy usually means less of some other good or service . . . Privacy for individuals may mean less information for others who deal with them. So it may reduce economic output. Thus, any legislation affecting the flow of personal information may have far-reaching, and not always desirable, effects on productivity and income distribution."

Within this framework, privacy is primarily an economic value and the presumption is *against* preserving it. Nonetheless, Brown and Gordon propose what to some is an orderly, rational market model: "Providers of information will be able to purchase the desired degree of privacy . . . and demanders will also get the information they want . . . Those with strong preferences for privacy will work for firms where little personal information about employees is needed. Those with fewer concerns about divulging facts on themselves will face a richer array of job opportunities."

This cost-benefit approach contains several fallacies. First, it's highly unlikely that we will be able to sell directly our own, personal information for its fair market value. Only one interactive cable system will

likely serve each locality, so a choice of different levels of privacy protection is impossible. Even if a competitive market does exist, most consumers will not have the expertise to understand how their private information will be used and which third parties might eventually have access to it.

The "willingness to pay" argument—that each person can "buy" the optimal level of privacy—hides another equity problem: the rich will be able to afford more privacy, while the poor might be forced to "choose" less privacy. The so-called free market will deny one segment of society a political right that should belong to everyone. It's analogous to a *New Yorker* cartoon in which the judge asks the defendant, "How much justice can you afford?" Do we value justice or privacy so little that we will sell it to the highest bidder? The seeming logic of the economic model violates our most basic, democratic values.

Defining privacy primarily as an economic good is convenient. But such a definition demeans our very understanding of privacy; we cherish privacy precisely because it is beyond economic concerns. When privacy is no longer regarded as a universal political right but instead as a commodity for economic barter, the door is thrown open for its exploitation. What individuals once enjoyed as free they must now pay a surcharge for—if they can afford the price. Under the "willingness to pay doctrine," a person's privacy rights become, with the development of interactive home media, virgin territory to be exploited to enhance corporate efficiency, profitability, and the GNP. This is the future sanctified by the Brown and Gordon report.

The promise of interactive home media is indeed exciting, but its dangers are equally strong. With his usual insight, Fred Friendly, the pioneering broadcast journalist, offered a profound comment on the issues at stake in his testimony before the New York City Board of Estimate's cable franchise proceedings. "These conduits," he said, "will determine what kind of people we are."

Deanna C. Nash is president of Collingwood Associates, Inc., a telecommunications consulting firm in Washington, D.C., and former director of system research at the Public Broadcasting Service. **David A. Bollier** is senior associate at Collingwood Associates. This article is based in part on "Interactive Home Media and Privacy Issues," a study recently completed by Collingwood Associates and John B. Smith for the Federal Trade Commission's Office of Policy Planning, and adapted from Dr. Nash's speech to a national cable television conference in Washington, D.C. this year.

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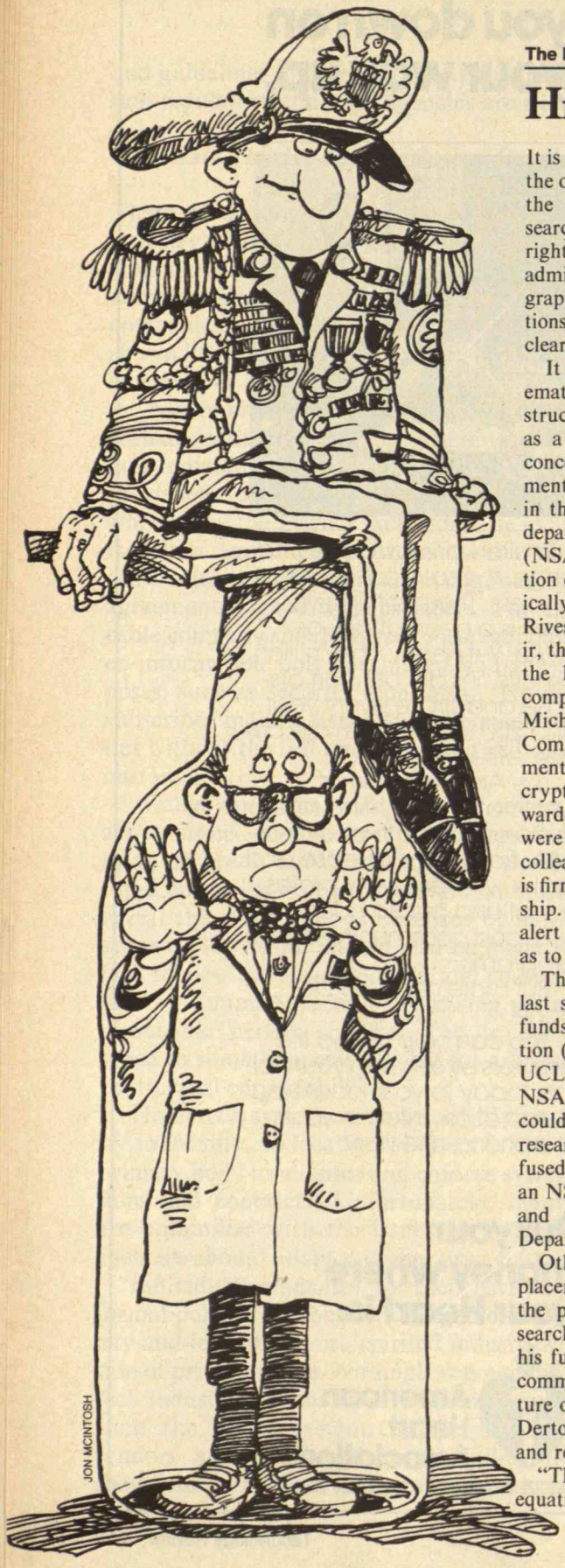


The Need to Know

High Technology: Back in the Bottle?

It is not a simple matter. This, it appears, is the only thing upon which those involved in the ongoing conflict over university research, national security, and the public's right to know can agree. And as scientists, administrators, and government authorities grapple, the issues grow murkier, the questions more difficult, and the premises less clear.

It started with cryptography—the mathematical enterprise encompassing the construction and deciphering of codes as well as a plethora of more esoteric academic concerns. Not surprisingly, the Department of Defense (DOD) has a keen interest in this area, and in 1977 a branch of the department, the National Security Agency (NSA), took steps to limit the dissemination of cryptographic information—specifically papers written by Professors Ronald Rivest, Leonard Adelman, and Adi Shamir, then of M.I.T. After much dispute over the legality of this action, a temporary compromise was negotiated by Professor Michael Dertouzos, director of the M.I.T. Computer Science Laboratory. The agreement stipulated that all further results of cryptographic research would be forwarded to the NSA at the same time they were sent out for review by professional colleagues. However, Professor Dertouzos is firm in his refusal to accept NSA censorship. "We send them our papers simply to alert them," he explains, not for decisions as to whether they should be published.

This arrangement worked well until late last summer, when a routine request for funds sent to the National Science Foundation (NSF) by Professor Adelman (now at UCLA) resulted in a sponsorship offer by NSA. Recognizing that NSA funding could lead to the classification of his research, Professor Adelman at first refused the offer, but he eventually agreed to an NSA prepublication review of his work and to its classification if the Defense Department so recommended.

Other M.I.T. scientists were not so complacent. Professor Rivest refused to accept the possibility of classification of his research and is still negotiating the terms of his funding. Meanwhile an M.I.T. faculty committee dubbed "On the Changing Nature of Information," chaired by Professor Dertouzos, was formed to investigate this and related problems.

"The continuum from a mathematical equation to an algorithm to a computer chip is very large, and one has to think of the First Amendment consequences of interfering with it," says M.I.T. Provost Francis E. Low, a committee member. "Cryptographers have to protect the interests of society and the individual as well as those of national security."

As implied by its title, the Dertouzos committee is concerned with issues that go far beyond the boundaries of mathematical research. There are in fact three distinct categories of real or possible restriction that the group intends to investigate—military classification, contractually stipulated review, and export control. Military classification is a moot issue as far as M.I.T. is concerned, since no such research is presently allowed on campus (though classified work is carried out at affiliated Lincoln Laboratory).

The cryptography controversy falls into the second category, "contractual stipulations," the agreement that all research be screened by the military or some other authorizing body before publication. A group established by the American Council on Education (ACE) to look into this protocol at the NSA's request recently concluded that researchers should submit results to the NSA voluntarily, with the understanding that any recommendation of censorship would be open to appeal.

But the M.I.T. group was not satisfied with this advice and, according to Provost Low, has basically ignored it. "The ACE recommendation could lead to prior review, something we consider anathema," Professor Dertouzos explains. "The NSA wants to control (cryptographic) research, and while a voluntary review might sound mild, it is only one of what could be several small steps toward government control of university research."

The M.I.T. committee decided to make permanent their temporary plan—that of giving the NSA a look at cryptographic results at the same time they are sent out for peer review. Recently endorsed by the NSF Mathematics and Computer Science Advisory Committee, this policy protects the public interest as well as academic independence, Professor Dertouzos says.

"We see a tremendous need for cryptographic information in the civilian sector," he says, explaining that this field has applications in the prevention of computer crime and the protection of individual privacy. "But while the NSA exists to

protect the military interest in this area, there is no government body to protect the civilian interest." Therefore, he suggests, it is up to the individual researcher or institution to make sure that the taxpayers are aware of progress in the field.

The final restriction category, export control, would limit the information available to foreign interests. Under existing interpretations of the Export Administration Regulations (EAR), these "interests" include foreign faculty, staff, and students who the DOD fears will "leak" and eventually capitalize on information obtained during their tenure in the United States. Government attempts to plug these "leaks" are, in the view of many university representatives, a threat to academic freedom. Last February the presidents of Stanford, Cornell, the University of California, the California Institute of Technology, and M.I.T. sent a letter protesting this policy to the Secretaries of Commerce, State, and Defense, saying that "the science underlying high technology cannot be put back into the bottle."

No one is arguing against government control over truly sensitive information; military research done by government laboratories is routinely classified and therefore unavailable to unauthorized individuals. Objections stem from attempted government control over so-called "dual-use" technologies that can be applied in both the military and civilian sectors.

A key example is the Defense Department's very high speed integrated circuit (VHSIC) program. These microcircuits have military applications (as the "brains" of guided missiles, for example), but their development is also vital to the progress of the entire electronics industry. They are "like money; just about everything will be influenced by them in the future," says Professor Dertouzos. Last year when the DOD attempted to restrict the publication of unclassified research in this area, and the Department of Commerce barred a foreign professor from participating in VHSIC research at Cornell, the academic community responded with alarm.

"Most universities have concluded that performance of classified research is incompatible with their essential purposes," the college presidents said in their missive. "University scientists would prefer, for the most part, to change their field of interest rather than have their research and teaching so constrained."

Restrictions on the transfer of information haven't actually changed with the new administration, but they are being more tightly enforced. However, some observers comment that export rules do not provide any serious deterrent to foreign interests. Information can be obtained through any number of more devious channels, they say. Military classification, though far from leak-proof, is a much surer method of control. One suggested solution to the restriction of dual-use technology research is to isolate highly sensitive areas for classification rather than restrict entire research programs. However, no one has produced an objective formula for distinguishing classifiable from unclassifiable research.

"We are holding out for an appropriate mechanism of control in as nonconfrontational a way as we can," Provost Low says. "I think there's a good chance that eventually something can be worked out, but exactly what the final solution will be is not clear."—*E.R.S.* □

Energy

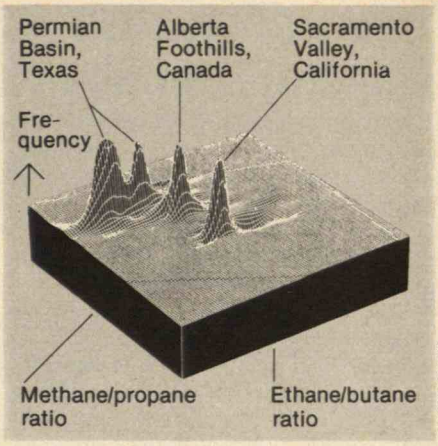
Sniffing for Oil

Drillers were drawn to the site of the first successful U.S. oil well at Titusville, Pa., by oil seeping from the ground nearby, and ever since then discharges of hydrocarbons—oil and especially gas—from the earth's surface have been accepted as clues to the fuels hidden beneath.

But Professor Martin J. Davidson of North Texas State University thinks these surface manifestations are far too little used by U.S. exploration companies. Indeed, our failure to exploit surface geochemical prospecting "inflicts a great cost upon this nation," he told the American Chemical Society last spring in Atlanta.

Professor Davidson's idea is that at least minute quantities of hydrocarbons constantly slip through even relatively impermeable layers of the earth. Fluids and gases under pressure follow cracks and fault lines from reservoirs toward the surface. Some are caught in aquifers and show up dissolved in surface water; some reach the surface to be found by extremely sensitive gas analysis. And often water with dissolved hydrocarbons can migrate through the rocks sealing such a reservoir when the hydrocarbons themselves cannot. Such seeps may represent but a few parts per million or even billion of air or water samples, but they have meant the difference between success and failure to some prospectors.

Consider, for example, the record of a prospecting company that made a heavy commitment to geochemical methods in the 1940s. Though only 8 percent of its total leases were based on geochemical evidence, by 1960 about 65 percent of its production was from such leases. Another company has drilled some 160 shafts in the last 40 years based on analyses of methane migrating vertically through the earth, and its 24 percent success rate is about twice the U.S. average.



The chart shows anomalous emissions of methane, propane, ethane, and butane plotted as ratios for three areas of West Texas, Canada, and California. The different ratios are good predictors of the different compositions of hydrocarbons that lie below.

J.C. Williams of Gulf Research and Development Co. agreed that the detection of hydrocarbon seeps "can play a major role in locating petroleum accumulations." He reported some of Gulf's results with marine geochemistry: an average of 0.14 liters of propane is dissolved per billion liters of water on the outer continental shelf of the East Coast. But in one area that "clearly shows evidence of petroleum," the mean is 2.7 liters per billion, and similar anomalous methane concentrations show up in many more locations. Some of the methane comes from decaying vegetation in shallow sediments, but some is believed to have escaped from deep-earth reservoirs of natural gas. Similarly, propane anomalies may be associated with petroleum reservoirs. When the two are found together, Gulf geochemists think that their ratio can help predict the likelihood of gas or petroleum deposits—more methane, more gas; more propane, more oil.

Mr. Williams thinks that even in areas of hydrocarbon seepage, "It's advantageous to collect and review geophysical data first." In contrast, Professor Davidson inists that geochemical data provide "an entirely new—and neglected—vista for oil exploration."—*J.M.* □

What's Good for General Solars . . . .

"We're helping solar energy grow through competition," declared Exxon's full-page ad in the *New York Times*. "It will grow into an important energy source for America because of the contributions of many people and the many companies that will be competing for your business."

That was 1977, and not everyone was convinced that the company's motives were so benevolent: in a letter to its president, Representative Richard Ottinger and Senator Gary Hart asserted that "Exxon intends for solar energy to be kept under wraps until fossil-fuel markets are exhausted." It turned out that Exxon was right about growth—phenomenal growth—not in the use of solar energy per se, however, but in its control, mostly through acquisitions, by large corporations in general and oil companies in particular.

For example, the *Wall Street Journal* recently reported that of the approximately 40 small companies producing photovoltaic systems, big oil now owns, wholly or in part, more than half. And while the American Petroleum Institute acknowledges that oil companies control 77 percent of the solar-electric industry's sales, some federal officials claim the number is closer to 90 percent, up from about 50 percent in 1978.

To those who like to think that solar energy is strictly the domain of backyard tinkerers, and that its commercial opportunities are patiently waiting in the wings for nascent Edisons and Fords, such news is indeed a rude awakening. In the language of the 1960s, it appears that solar is being coopted by "the system."

But is this an ominous or a healthy indication? Annual solar-electric sales, according to a recent projection by the Department of Energy (DOE), are expected to grow from the current $50 million to $1 billion in 1985. The spate of corporate activity in the field, therefore, could simply be the sincerest form of economic flattery: investors being drawn to a promising enterprise.

The energy problem, according to Daniel Yergin of Harvard University, "is not likely to be solved by appeals to altruism and patriotism, but by concrete recognition of self-interest." Barry Commoner, no apologist for big business, viewed the situation with equanimity a few years ago when he advised critics of corporate involvement "to look at solar from the problem-solving point of view. What do people need?"

Solar energy cannot by itself be a vehicle for revolutionary change, noted the Boston-based Union for Radical Political Economics (URPE) in a recent issue of its magazine, *Dollars & Sense*. For one thing, complete decentralization is not possible. Even with a windmill in every backyard and solar panels on every rooftop, there would still be the need for hooking into a utility grid (both to buy and sell power) and for other, conventional backup systems. A second reason is that decentralization is not necessarily hindered by the involvement of big business; it commands formidable resources with which to produce solar equipment inexpensively and in large quantities. Thus, concludes URPE, "Struggles against corporate manipulation of our energy future will not be over even with a conversion to widespread use of solar energy."

Which brings us back to competition. If the largest companies can undersell the small, independent producers, they can easily eliminate them. But then, without even the illusion of free-market competition, prices don't have to remain competitive, and neither do rates of productivity or innovation. (*See "Hidden-Foot Feedback: Wellspring of Economic Vitality" by Burton H. Klein, October 1980, p. 46.*) And with the various energy alternatives controlled by a handful of private decision makers, the price of solar power becomes less a function of competition than of corporate policy across all markets.

Even the "competition" for federal funds, supposedly one of the few aids to the small businessperson, becomes a losing battle. Paul Maycock, director of solar electricity at DOE, admitted to the *Wall Street Journal* that "it's difficult to do business with small firms because they lack sizable staffs and sophistication in presenting proposals." And he offered the following prediction: "In the end, we are going to have four companies, as in the automobile industry."—*S.J.M.* □

New Ripples in Wave Power

There is enough power in ocean waves—some 10^{13} watts worldwide—to satisfy present global demand for electricity. Research into harnessing that power, underway only since the 1973 oil embargo, has resulted in numerous types of devices. Electricity produced by the best costs about $1 per kilowatt-hour.

More effort and support has been poured into tidal power conversion, John N. Newman, professor of oceanography at M.I.T., told a public seminar at the New England Aquarium. But the extraction of useful power from waves is potentially more straightforward than from tides. Waves occur about every 5 to 10 seconds, while tides peak only twice daily; truly prodigious fixed conversion plants are needed to capture their power.

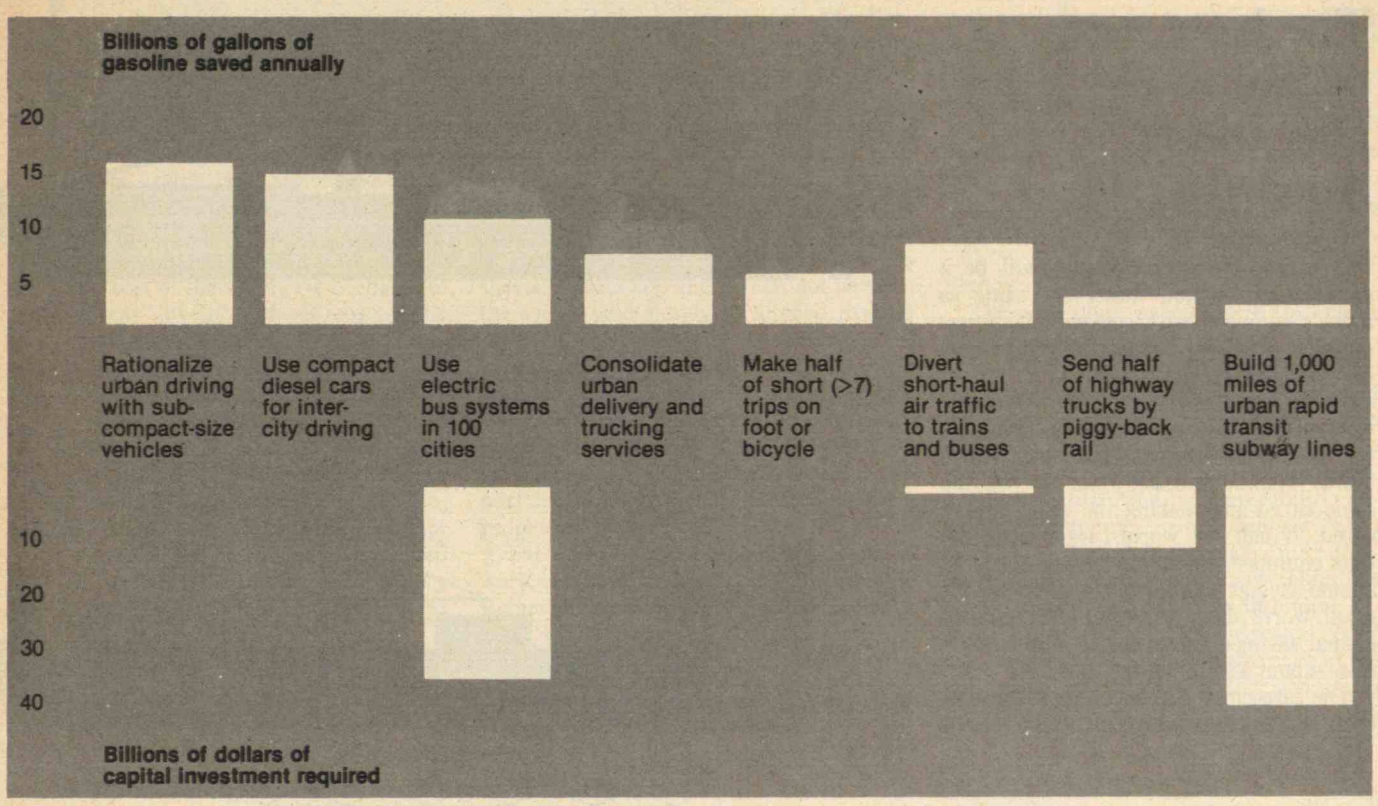
However, diminutive devices can harness useful amounts of power from waves (dispersed at an average of 30 to 50 watts of potential power per meter of coastline). One raftlike machine produces electricity with articulated floats; others trap passing waves as oscillating columns of water, which are used to run pneumatic turbines. Moored cylinders rotate haltingly as waves lap against them; huge air bags mounted alongside boatlike platforms are squeezed and released; and tethered, floating cams rock in ducklike response to the undulations of the sea.

Perhaps the largest wave conversion machine, the *Kaimei*, is built on an 80-meter ship hull moored in the Sea of Japan. For two years its 20 turbines, powered by oscillating air/water columns, have churned out as much as 150 kilowatts of electricity, some of which powers warning beacons aboard, with the remainder sent ashore. Its output could be increased an order of magnitude with some redesign, said Professor Newman.

With the aid of a film, he described a test-tank experiment being conducted at the Norwegian Institute of Technology, in which a bright red float bobs up and down forcefully in astonishing response to passing ripples. The aim of the work is to approach more closely the maximum efficiency, 94.7 percent, with which wave power can be collected (the "ducks" can achieve something over 80 percent).

A mechanical linkage stops the descent of the float just before it is struck by the trough between consecutive crests of a ripple; it releases the float just after the trough passes. Similarly, the ascent of the float is stopped just prior to the arrival of a crest; release comes just after the crest passes. Thus, the momentum of the float will not cause it to waste energy by "burying" itself into a trough and thrusting itself above a crest.

Will further development of the Norwegian and other approaches prove successful in popularizing wave power conversion? Judging from audience interest at the seminar, even if the jury is out, the tide of interest is definitely on the way in.—*L.A.P.* □



OMNIGRAPHICS

Transportation

To Save Energy, Save the Auto

Above: The most effective ways for the U.S. to reduce its use of gasoline for transportation have essentially no capital cost, according to Professor Richard A. Rice of Carnegie-Mellon University. New, fuel-efficient automobiles for urban and intercity use have the most promise because the U.S. vehicle fleet is almost completely renewed every decade.

The prize for the best use of resources in the transportation sweepstakes belongs to the family car, and improvements to make automobiles still more efficient in and between cities are the best transportation choices the United States could make.

After an elaborate analysis of the way many different modes for moving freight and passengers use energy and capital resources, Professor Richard A. Rice of Carnegie-Mellon University concludes that the private automobile is far from the abysmal performer often portrayed, and its potential for the future is very high indeed. With almost no incremental investment, more efficient use of more economical automobiles in urban and interurban service could save the United States over 30 billion gallons of gasoline a year by the 1990s. Indeed, the private automobile "appears to be the only mode that may actually effect a near doubling of energy yield in the next ten years . . . dwarfing all other conceivably available energy savings by a factor of 10 to 20."

The leading freight transporters are general-purpose cargo trains and pipelines, and increased use of these in place of airfreight and highway trucks has the greatest potential for future fuel savings.

Professor Rice's conclusions result from an elaborate compilation of transportation yields of various modes for given inputs of capital and energy, and of the improved yields that could be achieved in the future through new investment in technology and equipment. The automobile wins for three reasons:

☐ It is ubiquitous: a modest improvement in any parameter becomes very significant in national statistics. For example, an increase of five miles per gallon in the average gasoline consumption of the U.S. automobile fleet could result in annual savings of 7 to 8 billion gallons of fuel.

☐ Its lifetime is short, so the extra capital investment necessary to achieve fuel savings in a decade's time is almost nil.

☐ The infrastructure is in place: no massive investments of capital or energy are needed to improve economy and usefulness.

Only two other changes in the U.S. transportation system can yield reduced gasoline consumption without significant new capital investment, according to Professor Rice. Consolidation of urban trucking services to eliminate duplication could save 6 billion gallons of gasoline, and substitution of walking or bicycling for the family car in half of our short (less than three miles) trips, saving 5 billion gallons.

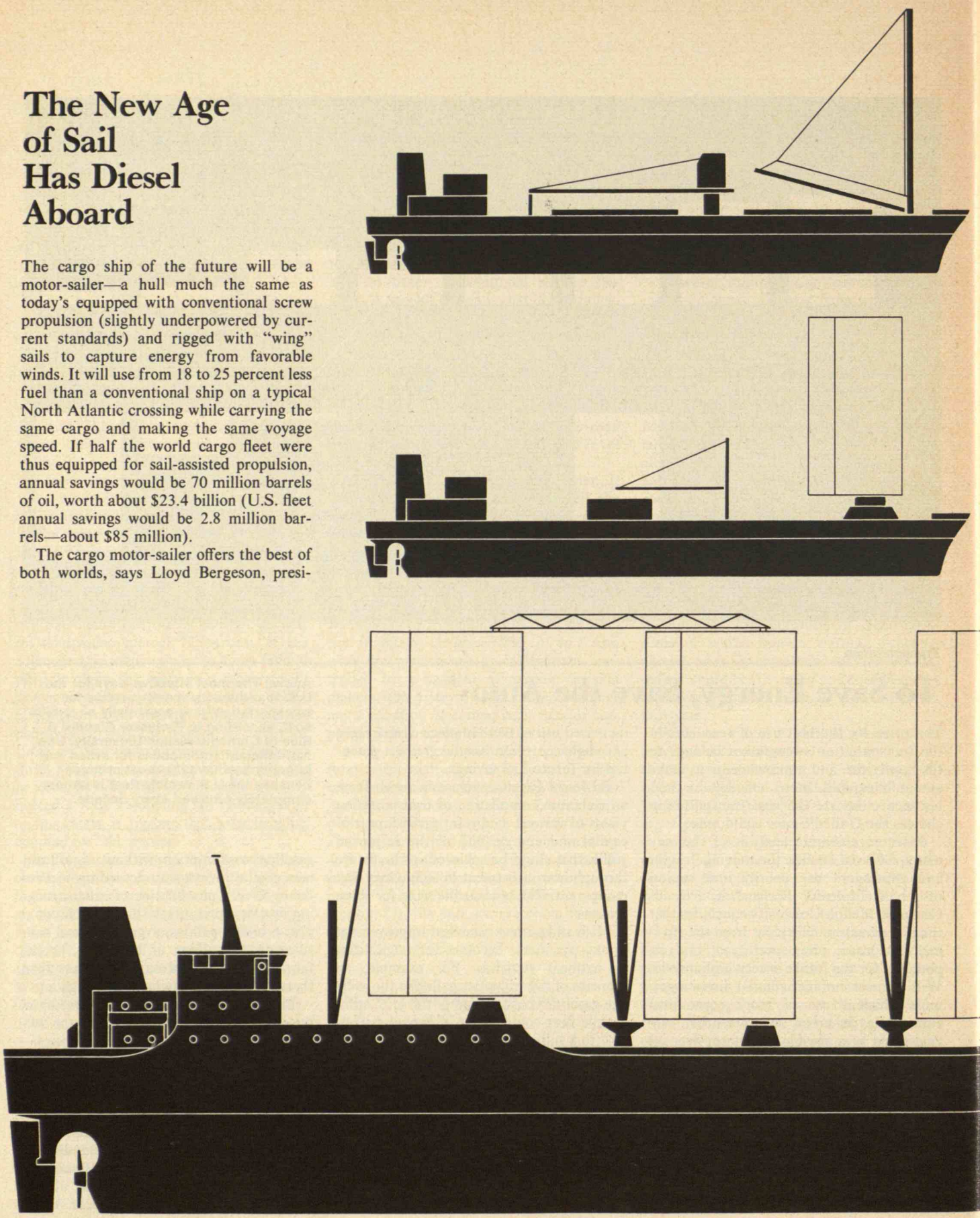
The substitution of electric for diesel buses in 100 large cities will offer the second largest source of petroleum savings—10 billion gallons by 1990—proposes Professor Rice, but the price tag would be $35 billion invested in new facilities.

Radical new technology is not a factor in energy economy, says Professor Rice. "There are apparently available today the alternative technical and systems concepts to vastly increase fuel yields" in all the major transportation sectors.—*J.M.* ☐

The New Age of Sail Has Diesel Aboard

The cargo ship of the future will be a motor-sailer—a hull much the same as today's equipped with conventional screw propulsion (slightly underpowered by current standards) and rigged with "wing" sails to capture energy from favorable winds. It will use from 18 to 25 percent less fuel than a conventional ship on a typical North Atlantic crossing while carrying the same cargo and making the same voyage speed. If half the world cargo fleet were thus equipped for sail-assisted propulsion, annual savings would be 70 million barrels of oil, worth about $23.4 billion (U.S. fleet annual savings would be 2.8 million barrels—about $85 million).

The cargo motor-sailer offers the best of both worlds, says Lloyd Bergeson, presi-



dent of the Wind Ship Development Corp. of Norwell, Mass.: it uses conventional propulsion when winds are adverse and when entering or leaving port, and it draws energy from the wind on the high seas, where winds are likely to be strongest. The cost penalty for having both motor and sail is negligible: "Sail-assist ships are found to cost essentially the same as equivalent motor ships," writes Mr. Bergeson, because the extra cost of the sailing rig is offset "to some extent" by the reduced cost of the smaller machinery required.

A year-long study of the sail-assist concept for the U.S. Maritime Administration using computer simulations of cargo ships of various sizes shows "no barriers to implementation," Mr. Bergeson reports. "Such a ship appears to be technically feasible at present," he told a meeting of ship-sail enthusiasts at M.I.T. What's needed now is "systematic rather than desultory development of commercial sailing ships for U.S.-flag ocean-borne commerce."

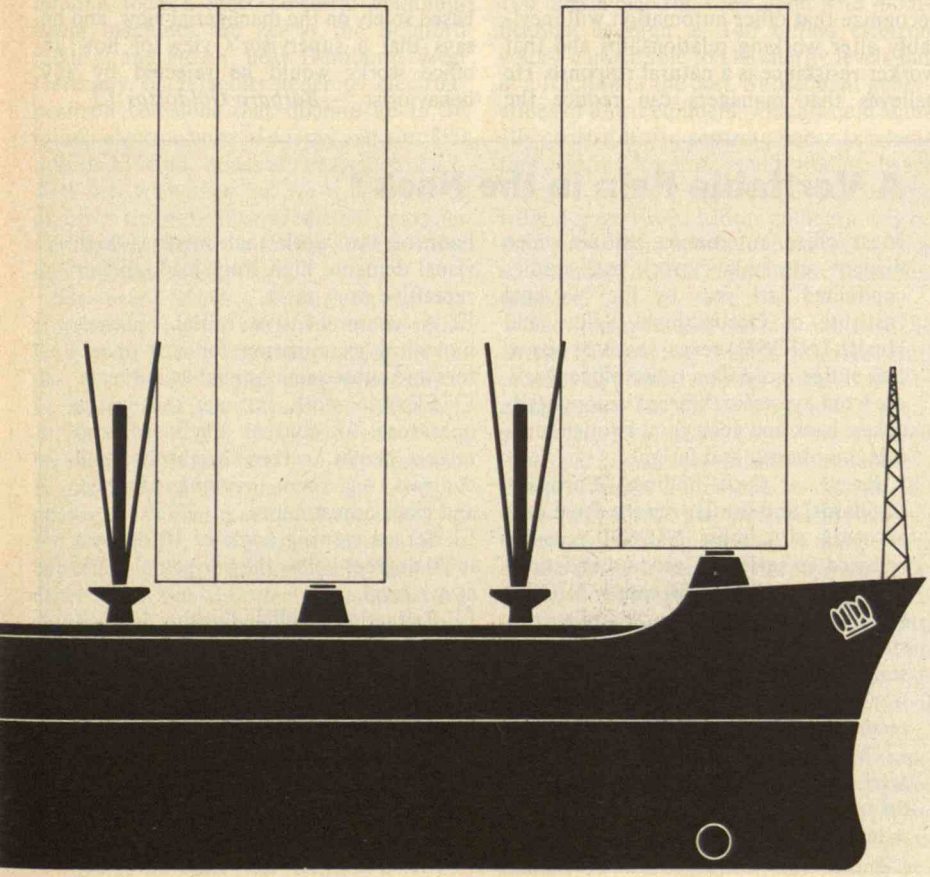
After detailed studies of several forms of rigging—square rigs, cat rigs, fore-and-aft rigs, and even rotors and horizontal-axis and vertical-axis wind turbines—Mr. Bergeson and his associates chose permanently mounted "wing" sails, like vertical airplane wings on unstayed, cantilever masts. Their operation would be automated so that a wind-assisted ship would require a crew no larger than on today's cargo ship of equivalent size. Trimming would be accomplished simply by rotating the sails to the appropriate angle to the wind—no winches, no sheets, and no hoisting. When not needed, the sails would simply be aligned parallel with the wind.

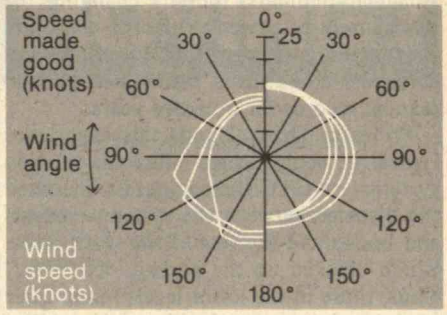
Sail-assist systems turn out to have greatest potential for small ships—40,000 tons and lower. Indeed, Mr. Bergeson believes that "the majority of ships forecast for construction in the United States in the next decade could benefit from sail-assisted propulsion."

There are inverse economies of scale at work, according to the Wind Ship analysis. Bigger ships require larger, more expensive sails, but conventional power plants for large ships are hardly more expensive than for small ones. Tankers are an obvious choice because the sails would not interfere with cargo handling. But Mr. Bergeson is confident that the masts used for "wing" sails could be designed to double as cargo-handling gear.

No major changes in hull forms or depths would be required for sail-assist operation. Indeed, many existing cargo ships could gain the advantages of sails through retrofitting, says Mr. Bergeson, and "a significant opportunity" exists for such work.

The next stage, according to the report which Wind Ship Development Corp. prepared for the U.S. Department of Commerce, should be a three-year research and development program. We should make more computer simulations of sail-equipped cargo ships to confirm their seakeeping qualities and maneuverability; develop a prototype "wing" sail rig for a 2,000-ton cargo ship (big enough to demonstrate both problems and advantages but small enough to avoid exhorbitant expense); and design, build, and test a 2,000-ton sail-assisted ship in cargo service in the Caribbean, where ships of this size are in demand.—*J.M.* □





OMNIGRAPHICS

Two modest cargo-carrying motor-sailers of the present (*top and middle*) and a future design (*left*) with its computer-simulated performance (*above*). The smaller vessels are general-purpose 3,000-ton cargo ships with identical 200-foot hulls, one rigged like a catboat and one with a "wing" sail. Both are scheduled to be at sea this year under the ownership of Ceres Hellenic Shipping Enterprises of Piraeus, Greece. The 550-foot, 20,000-ton (deadweight) vessel at left would carry five "wing" sails having a total area of 35,800 square feet.

In the simulation above, the ship's engines are assumed to be driving the ship with enough thrust to propel it at 12 knots, with winds of various strengths and directions increasing the ship's speed to as much as 20 knots. Such a sail-assisted ship is now "technically feasible," according to a report of Wind Ship Development Corp., and future systematic development could lead to significant savings of fuel and money.

In Process

The Politics of Office Automation

Office automation, lauded as the latest way to reduce paperwork and maximize efficiency in the nation's fastest-growing sector, may also be an instrument of control that determines the distribution of power.

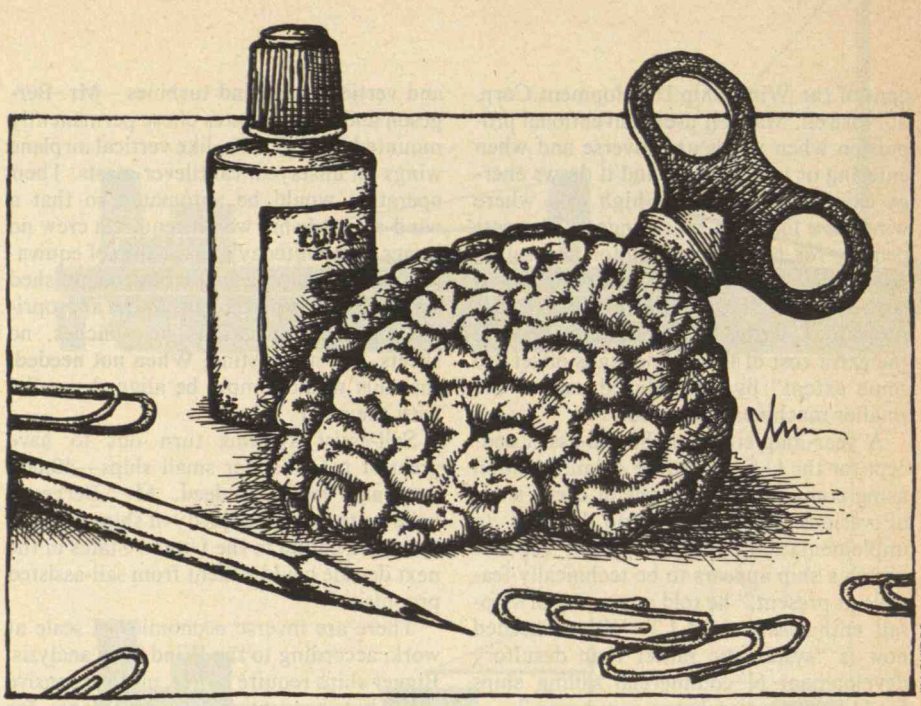
Extensive automated systems that control office activities and make decisions are likely to redistribute power at the expense of lower-level workers, says James W. Driscoll, assistant professor of industrial relations at M.I.T.'s Sloan School of Management. And his colleague, M. Lynne Markus, assistant professor in the Sloan School's Center for Information Systems Research, adds an example of such a program at a real company that she fictitiously calls the Golden Triangle Corp. (GTC).

The trouble at GTC began with a complex computerized information system that promised to streamline financial reporting. However, in practice it gave more information directly to corporate accountants and decreased the control of lower-level, divisional accountants, thereby changing the distribution of power. Although corporate accountants welcomed the new equipment, divisional accountants maintained parallel manual records for over two years.

Professor Driscoll finds this experience typical of sophisticated office automation systems. At GTC the computers increased the distance between the systems analysts and bosses and the rest of the work force, which "picked up the garbage left over." Thus, those in the lower levels found their work less interesting, had less job mobility because of the great gap between their work and higher-level work, and had less influence on the quality of their work.

Professor Driscoll believes that offices controlled by these machines "neglect the interdependent nature of office work as the product of many people." By maximizing specialization, centralization, and machine efficiency, such arrangements destroy the motivation workers gain from social contacts and the nature of the work itself.

One of GTC's problems was that only corporate accountants had worked with the designers of the company's new system; divisional accountants did not participate. Indeed, one corporate accountant explained that the system actually had been devised to "find out how those knaves are doing down in the trenches." Professor Markus, recommends that designers study the actual situations where the equipment will be used and consult with workers who will be using it.



Marvin A. Sirbu, Jr., an "automated office" specialist in M.I.T.'s Center for Policy Alternatives, advises managers to recognize that office automation will inevitably alter working relationships and that worker resistance is a natural response. He believes that managers can reduce the resistance by preparing employees for such changes.

Professor Driscoll emphasizes this responsibility of designers and managers in moving automation onto a "humanistic path." Automated systems should not be based solely on the managerial view, and he says that a supervisor's view of how an office works would be rejected by any behaviorist."—*Barbara Goldoftas* ☐

A Veritable Pain in the Neck?

Most office automation utilizes video display terminals (VDTs), and studies conducted last year by the National Institute of Occupational Safety and Health (NIOSH) reveal that VDT operators suffer more than other office workers from eyestrain, blurred vision, headaches, back and neck pain, swollen muscles, numbness, and fatigue.

Based on these findings, European standards, and similar reports from other work situations, NIOSH recently released a series of recommendations for VDT operators. (Because NIOSH has no regulatory power, compliance is strictly voluntary, but the proposed standards do provide guidelines for workers, unions, and employers.) The recommendations include:

☐ Mandatory 15-minute rest breaks after two hours of continuous VDT work for operators under moderate visual demands and/or work load, or after one hour of VDT work that involves high visual demand, high work load, and/or repetitive work tasks.

☐ A comprehensive initial ophthalmological examination for VDT operators and subsequent annual vision tests.

☐ Flexible work stations that allow operators to control keyboard and screen height, screen brightness and contrast, leg room, viewing distance, and chair adjustments.

☐ Screen viewing angle of 10 degrees to 20 degrees below the horizontal plane at eye level.

☐ Reduction of office lighting intensity to about one-third that recommended for general office activities.

☐ Glare control by means of drapes or blinds over windows to limit direct sunlight, careful positioning of VDTs with respect to lighting, screen hoods and antiglare filters, and recessed or indirect lighting.—*B.G.* ☐

Fundamentals

High-Energy Physics: Aiming Straight for the Future

Physicists at the Stanford Linear Accelerator Center (SLAC) are planning literally to straighten out their act with a new design for a particle accelerator called the linear collider. It's a significant departure from the storage-ring design that dominated particle physics for the last two decades, and the Stanford group, led by Nobel laureate Burton Richter, says it promises to deliver high-energy subatomic particles at affordable cost.

Since the first ones were built in the late 1950s, such machines used "storage rings" in which two bundles of subatomic particles whirl around and around in opposite directions close to light speed. When the beams intersect, a small fraction of their constituent particles collide, creating a shower of other particles that physicists can detect and study.

Over the years, larger machines supplied particle beams at progressively higher energies, enabling physicists to probe deeper into the fundamental structure of matter. Among today's most powerful colliding-beam machines are PEP at the Stanford facility, and PETRA, near Hamburg, West Germany. Each facility generates electron-positron collisions that liberate up to 36 billion electron volts of energy and cost $80 million to build. It was at PETRA that physicists saw what they believe is evidence of gluons, theoretically predicted particles that intermediate the strong nuclear force holding quarks together.

However, SLAC's linear collider will employ a souped-up version of its two-mile-long linear accelerator, used largely in the past decade to feed high-energy particles to its more-publicized storage-ring offshoots, SPEAR and PEP. The linear accelerator will be modified to produce two simultaneous beams—one of electrons and the other of positrons—which race down the length of the accelerator, split apart at the end, curve back along a large arc, and slam into each other. It's a one-shot deal—the beams are discarded after the collision. As seen from above, the system layout resembles an enormous lollypop.

The SLAC linear collider is being designed because the evolution of increasingly powerful storage rings is fated to end, and soon, says Richter. They are simply becoming too expensive to build. LEP, a sprawling storage ring 20 miles in circumference to be built near Geneva, Switzerland by the European Center for Nuclear Research (CERN), will cost at least $600 million. Scheduled to run in 1988, it could well be the world's greatest—and last—electron-positron storage ring.

The exponential leap in cost is due to a phenomenon known as synchrotron radiation. As charged particles are forced to bend by a corral of powerful magnets, they lose energy by emitting this radiation. The energy must continually be replenished, creating tremendous energy bills. This immutable economic fact is most distressing to physicists, who believe that the energy realm just around the corner (in the range of 90 to 150 billion electron volts) contains information about a broad range of fundamental physics questions. However, the SLAC linear collider would not emit wasteful synchrotron radiation because it involves straight rather than curved colliding beams.

With the SLAC linear collider, Richter hopes to produce collisions with energies of 100 billion electron volts—and with modification, as high as 140 billion electron volts—comparable to LEP energy levels but at a fraction of the cost. Subsequent generations of linear colliders, which would actually consist of two separate linear accelerators meeting head on, could produce beam energies that are economically unfeasible with storage rings. Linear colliders will be the "only way to continue to do the physics of electron-positron interactions," Richter predicts.

The linear collider idea is not new, he notes. However, it wasn't possible until recently to generate useful amounts of data using such a device. Problem was, the linear accelerator pulses but a few hundred times per second compared with machines like PEP, which can collide beams 100,000 times per second. But advances in focusing technology enable physicists to compensate for the slower cycle by concentrating linear accelerator beams to extremely high densities, producing more particle collisions. Storage rings cannot attain such high densities because the two beams become significantly "unfocused" by repeated mutual electromagnetic interaction.

Physicists expect to find new information from the linear collider on the number of basic forces in nature. Previously, physicists believed there were four forces—gravitation, electromagnetism, the strong nuclear force holding atomic nuclei and quarks together, and the weak nuclear force responsible for beta decay.

Recently, however, physicists developed a new conceptual framework in which the electromagnetic and weak force are believed to be different manifestations of the same force. Known as gauge theory, this concept predicts that a new particle called the "heavy neutral gauge particle" will emerge from electron-positron collisions of 100 billion electron volts. This particle is believed to intermediate the weak force the way a particle of light, or photon, intermediates the electromagnetic force. If it is not found, physicists may have to overhaul their theory of the basic forces. In either case, the linear collider could play a critical role in shaping physics for the next several decades.—*J.K.* □

Macroengineering

Five Red Flags for Macroengineering

For engineers used to building $200-million chemical plants, a multi-billion dollar synthetic-fuel plant to produce oil from shale or tar sands is a whole new ball game—a superproject where problems are tougher, risks greater, and conventional engineering management inadequate, often by orders of magnitude. It comes down to a greater need than ever for "innovative and extraordinary engineering practice," Edward E. David, Jr., president of Exxon Research and Engineering Co., told an audience of M.I.T. students and faculty.

"Problem projects"—those on which major cost overruns and delays are most likely—have one or more of these characteristics, according to Drs. David and Werner Glass, senior staff advisor at Exxon:

They involve the coordination of several different engineering teams. Three to ten million hours of engineering effort may be required for a major synfuel plant, and no one engineering firm is big enough to do it. For a huge, $10 billion Exxon project the central coordinating organization will spend $500 million to tie together the work of five or more engineering contractors.

They involve new technology. Dr. David's only prescription for the unexpected technical problems inevitable in a project based on new technology includes experience, careful laboratory and pilot plant testing, and good management.

They involve economic uncertainty—such as a volatile inflation rate. Dr. David has a prescription here, too, known at Exxon as "David's Rule": "When you've finished the planning and estimating, multiply the schedule duration by two and the cost by four."

They are in remote locations. Exxon's experience in recent remote projects is that some 40 percent of the total labor force is involved in activities "not directly contributing to building the plant." That compares with 15 to 25 percent in Britain and on the U.S. Gulf Coast.

They are likely to encounter or create labor shortages. The most surprising of Dr. David's statistics were those in support of this hazard. Exxon's first syncrude project in Alberta required a peak labor force of 8,000 mostly skilled craftspeople. Turnover was so high that maintaining the labor force required hiring 60,000 people in five years—3,000 in one peak month.

Labor demand is high because projects are large and productivity low. Consider statistics from Dr. David and Mr. Glass on a recent major Exxon refinery project in Britain. If every worker had been on the job for the full 54-hour work week while employed, Exxon would have had available 7.5 million work-hours. But only 5.9 million work-hours were actually put on the time clocks; 1.1 million work-hours were lost to absenteeism, 300,000 to holidays, 206,000 to early quits and late starts, 117,000 to major strikes, and 78,000 to minor walkouts. Clocked hours were further reduced by weather and other frustrations, and in the end 4.5 million work-hours were available to build the refinery—about 60 percent of the 7.5 million with which Exxon started out.

There were productivity troubles at the British refinery job, too. Measured against Exxon's "norms" for the various jobs involved, the productivity of the British work force was only 56 percent. Part of this problem is reflected in the 265,000 work-hours that went into "rework"—correcting errors.

The process of estimating the effects of these five warning signs on the cost and duration of Exxon's macroengineering jobs remains too "mechanical" and arbitrary for Dr. David's taste. And there is still no good way to predict the interactive effects of these factors—an example of the "innovative engineering" required for macroengineering projects such as major synfuels facilities.—*J.M.* □

Solution May/June Crostic

In the space of one hundred and seventy-six years the lower Mississippi has shortened itself two hundred and forty-two miles. . . . Therefore, any calm person . . . can see that . . . just a million years ago last November, the lower Mississippi River was upward of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing rod.

Mark Twain, *Life on the Mississippi*, Harper, New York, 1974

Last Line

Writing Tools

Through the portals of "Lobby 7" at M.I.T. pass students who will soon be ranked among the best-credentialed technologists in the world. And on a pillar of these portals there is sometimes a poster, initially blank, that invites them to scribble their thoughts—in response to whatever statement or question starts it off—for the community, and occasionally the world, to see.

This arrangement assumes a certain depth of thought, and ability to express it, among the passers-by, but a persistent stereotype of M.I.T. students and engineers in general holds that they ain't got no culture. Or, in more modern lingo, they allegedly lack "communications skills." According to some observers, these nascent scientists and engineers not only speak and write poorly, but they are content, even determined, to maintain that deficiency just when the rest of the world is most expecting clarity and enlightenment.

Kenneth Manning (associate professor of science, technology, and society and a member of the Committee on Educational Policy) recently used the pillar-poster mechanism to try to learn the straight poop, at least locally, on whether engineers can write and whether they care. His lead-off question was "What sort of writing proficiency should there be at M.I.T., if any?" and he agreed to let *Technology Review* (which has a more-than-passing interest in the communication of science and technology) share some of the results with its readers.—*S.J.M.*

I Am Not Unwilling . . .

The level of proficiency should be just enough to write graffiti and wisecracks on pillar posters.

What are an writing profishancy?
Me tinks its big and green or sumtin.

Writing is fundamental. Through writing, one learns how better to express oneself. Learning how to communicate succinctly and efficiently is all-important in our modern world.
Yes, tuowhogyoqqw3uoo coherence and zxzwoyrow legibility.

What good is knowing something, or discovering something, if you can't tell anyone else in a way they understand?

JIM CHIROS

To Sink or Swim

It would be absurd to require a writing course at the college level. Next thing you know, there'll be a required drama course, or a required music course.
My God, we can't do that. We might graduate some people *(shudder).*
When was the last time you saw a gnurd turned human via Brahms?

Mandatory grammar and composition, one semester apiece. We are supposed to be getting an education, as distinguished from learning engineering. (Requiring drama or music is a good idea. There *is* a world out there.)
But we should have a say about how we explore it.
Some people come here knowing how to write. Requiring that of them would be cruel and unusual punishment.
People who already know how to write could get AP [advanced-placement] credit for the course, just as those who have studied calculus get AP credit for that.

In order to graduate, one must learn to swim but not to write. Isn't that ridiculous?
The ability to swim may save your life someday.
The ability to write may get you shot someday.
Then let's ban handguns.
Let's ban writing!

Looking at this poster, it seems people here are much better at mindless nit-picking than they are at making reasonable judgments and communicating them. Maybe that's what a writing course would teach. It's certainly what we need.

This is another fine example of one group trying to impose its values on another. That Moral Majority mentality strikes again.

M.I.T. students write good, now.
Me think so two.
We don't need none.

Educator, Teach Thyself

How about a required course in reading and speaking English for the TAs [teaching assistants]?
Foreign students aren't the only illiterates in this place!
I am a foreign student. I also speak and write more grammatically than some Americans I've met at M.I.T.

All professors/instructors should include some comments on how well written work is written, as well as on the substantive content of the work.
Assuming, of course, that they can.

Many faculty members qualify as illiterate, and until the Institute is willing to do something about *them,* I can't see doing something about students who learn from their teachers.
M.I.T. professors are poor writers and excellent writers. Writing skill isn't necessarily a function of a person's interest in technology.

Just as literary abilities may ≠ technical abilities, I see no reason to belittle scientists who may not write like Hemmingway.
They don't have to write like Hemmingway, just better than you.
You Hemingway fans should learn to spell his name.
We should all be able to spell Ron Guidry's name properly.
Or Carl Yastrzemski's.

I think there should be a required course in "writing theory," with weekly problem sets and a recitation with a TA who doesn't speak English. There should be four quizzes and a final, and, in order to be more like the other theoretical courses at M.I.T., there should *never* be any "worked examples." It should be left to the interested student to derive the English language from the sound theoretical basis learned in the course.

Prioritizing Language

1984 is 3 years away. Newspeak is clearly present here and you want even *less* English?
Let's first eschew obfuscation.
Obstreperous sesquipedalian!

I think the M.I.T. education is woefully deficient in that it does not also require at least one year of quantum psychology and one term of nuclear meteorology.

There is a general pattern in this society that stresses numbers over words. I, however, believe that words are more important than numbers, and this should be the attitude of the educated person.
I'd give this view a 10.
Yes, words are at least 2 or 3 times as important as numbers.

Stresses and Faults

M.I.T. students can't write because
a) they were never rigorously taught to write English, and
b) they do not use their writing skills on a regular basis (except for on unintelligible lab reports).

The fault lies with the Admissions Department.
The fault lies with public schools that don't teach.
If they're expecting us to learn to write here, what's the point of all those essays on the admissions papers? Aren't they supposed to screen *out* the illiterates?

By the time someone graduates from high school, he or she ought to be able to write. In fact, many graduates can't. But writing just isn't M.I.T.'s responsibility.
***Educating** people is M.I.T.'s responsibility, you turkey.*

The problem is not that incoming students can't write, but that by the time they graduate they can't write as well as they did when they were freshmen.
It should be illegal what they done to me at school. □

M.I.T. REPORTER

Cell Patent Licensed

A method of cell culture developed at M.I.T. for growing large volumes of cells at low cost for use in biological research has now been licensed to Flow General, Inc., of McLean, Va. The culture method was provisionally licensed to Flow two years ago. The new arrangements extend this agreement, licensing Flow General to carry out further development for mass production of human and other mammalian cells on which M.I.T. holds patents.

The method makes use of tiny beads of dextran, a starchlike substance; when given a positive electric charge, these tiny carriers attract cells that require a solid surface on which to grow. The beads are a remarkably efficient creator of surface: a bottle full of beads provides more than 100 times the growing surface of a conventional cell-culture bottle.

Flow General will pay a minimum annual royalty of $400,000 to M.I.T. through the life of the present arrangement. Half of that will be turned over to the Department of Nutrition and Food Science, where the original research was done, to support innovative faculty research in cell science and biotechnology. □

Let Industry Knock on Colleges' Door

The United States spends more on research and development and claims more Nobel Prizes than any other country in the world, yet we have one of the lowest rates of productivity growth among industrial democracies.

One reason for this puzzling dilemma, says Edward E. David, Jr., president of Exxon Research and Engineering Co.: industry's support and participation in university research are wholly inadequate. "American industry needs to draw more directly on the unique abilities and intellectual resources of university researchers," Dr. David told the American Society of Microbiology in Dallas last spring.

Dr. David does not propose that industry can substitute for government as a "mainstay" of academic research. But he believes industry's funding should be at least 15 percent of government support by the end of this decade. Assuming continuing levels of government support, that means $400 million more in industrial support (from $200 million to $600 million) in constant dollars by 1990.

And at the same time, Dr. David told the microbiologists, industry should "play a leading role in providing the financial means to correct . . . the dangerously low state of our science and engineering schools."

The universities have everything to gain and nothing to lose, said Dr. David, who holds a doctorate from the Institute and is a member of the M.I.T. Corporation. Government support of research is developing the shortcomings generally associated with industrial sponsorship, he said: a preference for low-risk, short-term programs with quick payouts, an "obsession" with accountability, and "extraordinary insensitivity to academic freedom." Meanwhile, universities will soon enough find that industry is "more concerned with research results than with accounting."

The universities are especially qualified in basic research, and "the insights of basic science can have a profound impact on technology.

"The time is right to revitalize a weary situation," Dr. David said. □

Understanding Propellers

A noticeable reduction in noise has been achieved by "Windsong," a new propeller designed at M.I.T. for general aviation aircraft. But the team that devised and tested "Windsong" thinks the sound reduction is a modest achievement. The more significant thing, say Professors K.U. Ingard, J.L. Kerrebrock, and E.E. Larrabee, is that they and their students have proved the value of an acoustic theory two years on the drawing boards. Now they have "a firm predictive methodology for performance and noise, so that the cost, performance, and noise trade-offs can be determined without recourse to expensive cut-and-try development." □

Diodes in the Round

A computer-driven video display system that generates a three-dimensional image, which the viewer can see from front, back, or side by simply walking around the display, awaits an entrepreneur in the M.I.T. Innovation Center. The system uses a matrix of light-emitting diodes creating over 4,000 miniature light bulbs. It's the brainchild of three recent students, and Professor David G. Jansson, director of the center, thinks it holds "considerable promise" in industrial, educational, and medical fields. Manufacturing cost is estimated to be $15,000 to $20,000 on a commercial basis. □

Business Is No Ally on Health-Care Costs

It is a myth that $2,000 of the price of a $5,500 American automobile can be attributed to the cost of health care for the workers who built it; the real figure is about $250. Indeed, employee health benefits amount to only 2 to 3 percent of U.S. corporate expenditures. But it is true that corporations are the largest single purchasers of health care in the United States.

That being the case, reasoned Professor Harvey M. Sapolsky and Drew Altman of the M.I.T. Department of Political Science, corporations rather than the U.S. government may have the crucial leverage to control spiraling health-care costs.

Not so, they found. In most corporations, health-care benefits are considered an adjunct to employee recruiting and labor relations activities and thus are likely to be valued highly as labor relations tools. "Corporations are neither greatly concerned nor strongly motivated to do much about their health benefit costs," write Professor Sapolsky and Mr. Altman. "The opportunity for close collaboration between business and government to contain health-care costs simply does not seem to exist."

On the other hand, if the benefit programs were transferred to the jurisdiction of "corporate financial managers, who naturally view every expenditure with a jaundiced eye . . ." □

The Truth About the "Tax Cap"

It's now one month into the first year of operation by Massachusetts cities and towns under "Proposition 2½," the "tax cap" referendum that limits property tax collections to a decreasing proportion of assessments. What will be its impact on taxpayers, municipal services, tax reform, and municipal management policies? Will Proposition 2½ live up to the expectations of those who voted for it by reducing inefficiency and corruption in Massachusetts local government?

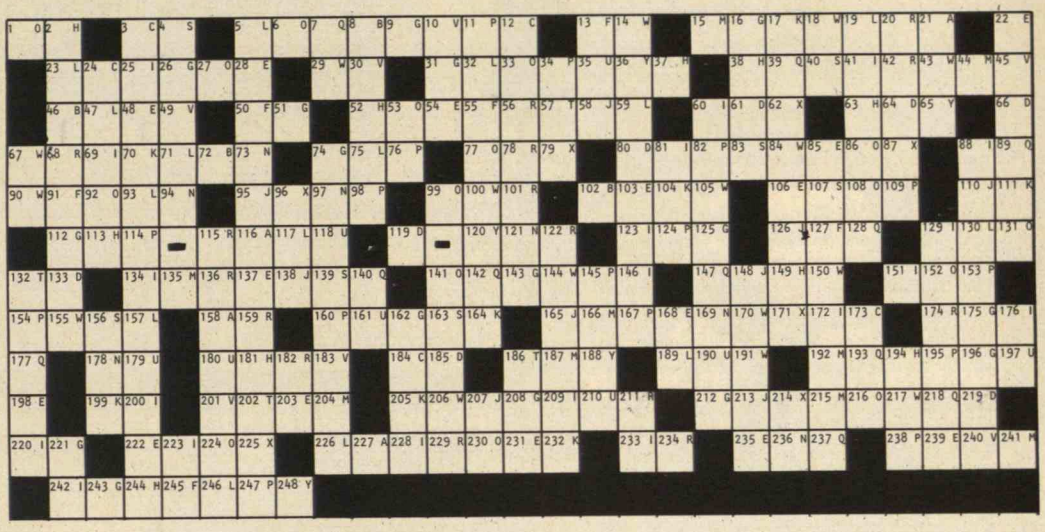
A two-year study of these questions—how cities and towns are responding to lower tax receipts, how user charges are substituting for taxes to provide essential services, how state taxes are affected—is now in place in the M.I.T. Department of Urban Studies and Planning. Professor Lawrence Susskind, head of the department, says he wants to offer "a neutral clearinghouse for data, analysis, and research" on the controversial subject. □

Physicists' Circus

Complete the word definitions; then enter the appropriate letters in the diagram to complete a quotation on particle physics.

The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate ends of words; if there is no black square at the right end of the diagram, the word continues on the next line.

The solution will be in the next issue, when another of Mr. Forsberg's puzzles will also appear. Readers are invited to comment—and to suggest favorite texts for future puzzles.



A German physicist and lens designer. 1840-1905

116 158 227 21

B "We take no note of time but from its ____" (Young, "Night Thoughts")

46 72 102 8

C Chief gods of the Teutonic pantheon

184 12 173 3 24

D Archbishop of Canterbury, 735-739

80 61 185 64 119 66 133 219

E Wagnerian soprano, 1895-1962 (full name)

48 85 239 106 168 203 28 235 137

103 198 222 231 22 54

F Type of large flightless bird

127 50 245 55 13 91

G Intermetallic semiconductor (2 words)

162 31 143 9 208 212 74 221 26

196 16 112 51 175 125 243

H Loud of voice

38 63 149 113 2 52 244 181 194

37

I "A Tenor____" (Gilbert & Sullivan. "Utopia Limited") (4 words)

69 123 41 60 146 25 88 220 151

134 81 209 200 228 223 129 176

233 242 172

J Document entirely in the originator's handwriting

148 110 138 213 207 58 126 165 95

K Pores in a leaf

232 164 199 104 17 70 205

L Invested with full power to transact business

23 117 32 75 47 5 226 189 93

157 130 19 246 71 59

M German WWI ace, 1890-1916

15 135 241 215 187 192 166 204 44

N Bliss: freedom from earthly pain and care

178 169 94 97 236 73 121

O Italian poet, 1562-1621, librettist of the first operas (full name)

6 77 99 152 92 141 27 53 108

216 33 224 230 1 86 131

P Creater of Mister Dooley, 1867-1936 (full name)

238 247 109 11 98 153 160 145 34

154 167 76 82 195 124 114

Q Novel by May Sarton, 1957 (3 words)

147 177 193 111 218 237 39 128 140

7 89 142

R German composer, 1926- "Elegy for Young Lovers" (full name)

78 136 56 234 174 229 122 42 159

211 115 101 20 182 68

S English sculptor. 1880-1959

139 107 4 83 156 40 163

T Dynasty ruling in Bihar and Bengal. 8th-12th century A.D.

202 186 132 57

U President Carter's Assistant for Communications

35 210 118 180 190 161 179 197

V Norwegian town where a Viking ship was unearthed

240 201 183 10 49 30 45

W Popular periodical (2 words)

217 105 170 100 206 14 67 29 18

150 84 144 155 43 191 90

X Queen whom Hercules served for five years

87 214 62 225 96 171 79

Y Swedish chemist and engineer. 1833-96

248 36 120 65 188

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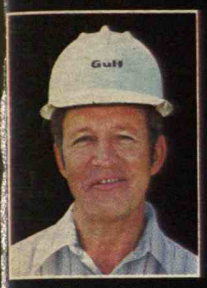

"There are still huge reserves of American oil left behind in oil fields that were tapped thirty or forty years ago," says Gulf Area Engineer John Shamburger. "In those days, crude was only two or three dollars a barrel, so we would operate an oil well only as long as the oil could be pumped up easily and inexpensively. It made more sense to drill new wells than to squeeze every drop out of old ones."

"In many of these old wells, the underground pressure is so low that the oil won't come up without some extra help. The extra help is called tertiary recovery, and it's a whole technology in itself. Here at Heidelberg, Mississippi, we started experimenting with it in 1971.

"One way to build up underground pressure is to set fire to some of the oil deep in the earth. That's called fireflooding. It drives the rest of the oil toward the well, where it can be pumped to the surface. The improvement can be pretty dramatic; in one case, production increased from one hundred to 2300 barrels per day.

"In other parts of the country, with different geology, we might use water, steam, or chemicals to get the oil flowing."

All over America, Gulf is using one or another of these technologies to get more oil out of old wells. It isn't cheap and it isn't easy, but it is a certain source of made-in-America energy for tomorrow.

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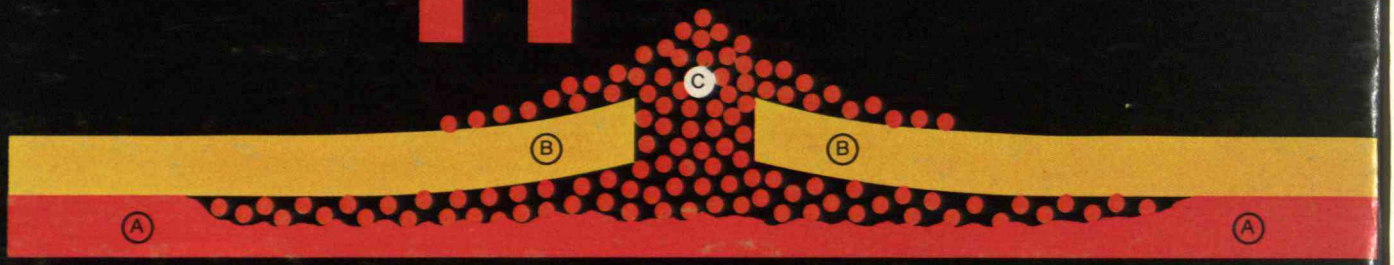
11 Porsche 911



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Our goal of the longlife car has shown, however, that components such as the engine and drive train can have a far longer life span than the body. Road salt, acid rain, and other aggressive airborne matter have created increasing demands on the body's protective coating. Now more than ever, there is the danger of rust.

Paint alone is no protection against rust. (See diagram above.) Harmful elements can attack a car's sheet steel (A) through pinholes in the paint skin (B). Unchecked, rust (C) can expand, mar the finish, and weaken an ordinary steel body. So in addition to a 4-step paint process, the Porsche 911—like all Porsches—is protected by a hot dip galvanizing process.

All of the sheet steel used in all Porsches is hot dip galvanized—on both sides—in a 500°C liquid zinc bath. This produces (see diagram below) a protective zinc coating (D) on the sheet steel (E) that actually *grows* into the damaged portion (F) of the paint skin (G)—plugging pinholes and preventing further corrosion.

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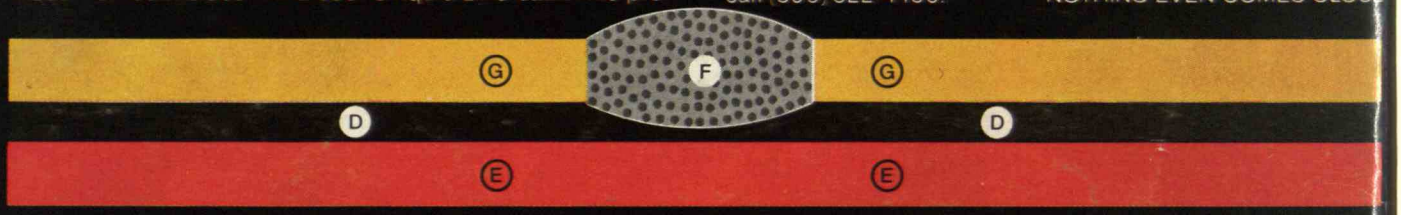

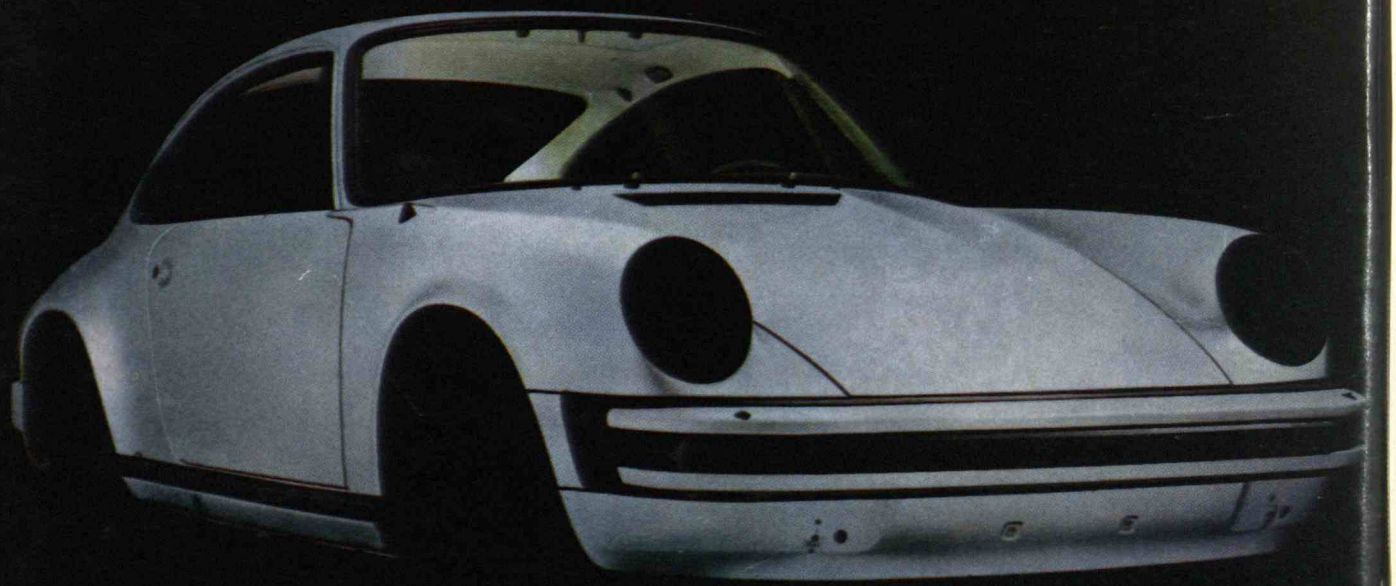

At the Porsche Research and Development Center (Entwicklungzentrum) in Weissach, the steel body of a Porsche 911 has been standing outside in the elements—protected only by hot dip galvanizing—for 7 years. To date, there has not been one speck of red rust.